Fuji Electric

Innovating Energy Technology

RS-485 USER'S MANUAL

FRENIC-AQUA Series

FRENIC-HVAC Series

24A7-E-0021b

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FRENIC-HVAC
FRENIC-AQUA

RS-485 Communication User's Manual

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Preface

Using the RJ-45 connector (modular jack) designed for keypad connection or the control circuit terminal block on the inverter unit enables functionality expansion for RS-485 communication. The RJ-45 connector also makes it possible to operate the keypad at a remote site.

This manual describes the functionality expansion. For the handling of the inverter, refer to the User's Manual and Instruction Manual of the inverter.

Read through this manual and become familiar with the handling procedure for correct use. Improper handling may result in malfunction, a shorter service life, or even a failure of this product.

The tables below list the relevant documents. Use them according to your purpose.

FRENIC-HVAC

Name	Document number	Description
User's Manual	24A7-E-0034	Overview of FRENIC-HVAC, how to operate the keypad, control block diagrams, selection of peripherals, capacity selection, specifications, function codes, etc.
Catalog	24A1-E-0012	Overview of FRENIC-HVAC, features, specifications, outline drawings, options, etc.
Instruction Manual	INR-SI47-1610-E	Inspection at the time of product arrival, installation and wiring, how to operate the keypad, troubleshooting, maintenance and inspection, specifications, etc.

FRENIC-AQUA

Name	Document number	Description
User's Manual	24A7-E-0077	Overview of FRENIC-AQUA, how to operate the keypad, control block diagrams, selection of peripherals, capacity selection, specifications, function codes, etc.
Catalog	24A1-E-0013	Overview of FRENIC-AQUA, features, specifications, outline drawings, options, etc.
Instruction Manual	INR-SI47-1611-E	Inspection at the time of product arrival, installation and wiring, how to operate the keypad, troubleshooting, maintenance and inspection, specifications, etc.

These documents are subject to revision as appropriate. Obtain the latest versions when using the product.

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■ Safety Precautions

Prior to installation, connection (wiring), operation, maintenance or inspection, read through this user's manual as well as the instruction and installation manuals to ensure proper operation of the product. Familiarize yourself with all information required for proper use, including knowledge relating to the product, safety information, and precautions.

This user's manual classifies safety precautions as shown below according to the severity of the accident that may occur if you fail to observe the precaution:

⚠WARNING	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in death or serious bodily injuries.
⚠CAUTION	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in minor or light bodily injuries and/or substantial property damage.

Failure to heed the information contained under the CAUTION title can also result in serious consequences. These safety precautions are of utmost importance and must be observed at all times.

⚠CAUTION
The FRENIC-HVAC/AQUA is not designed for use in appliances and machinery on which lives depend. Consult Fuji before considering the FRENIC-HVAC/AQUA series of inverters for equipment and machinery related to nuclear power control, aerospace uses, medical uses or transportation. When the product is to be used with any machinery or equipment on which lives depend or with machinery or equipment which could cause serious loss or damage should this product malfunction or fail, ensure that appropriate safety devices and/or equipment are installed.

Wiring

⚠WARNING⚠
- Before starting wiring, confirm that the power is turned OFF (open). **An electric shock may result.**

⚠CAUTION
- The product cannot be connected directly to an RS-232C interface of a computer. - When connecting a device cable to the RJ-45 connector (modular jack, designed for keypad connection), confirm the wiring of the device beforehand. The RJ-45 connector has the pins connected to the keypad power supply (pins 1, 2, 3, 7 and 8). When connecting the inverter with a device such as other inverters via a communications cable, take care not to connect the wiring of the device to those pins assigned to the power supply. For details, refer to Chapter 2, Section 2.2 "Connections." - When the inverter is connected with the FVR-E11S series, a power short-circuit or a collision of signal lines may occur, resulting in a damaged inverter. For details, refer to Chapter 2, Section 2.2.2 "Connection notes." **Failure may result.**

Operation

⚠WARNING
- Never reset an alarm state with a run command being ON (closed). Doing so may cause the inverter to supply power to the motor so that the motor runs. **An accident may result.**

Table of Contents

CHAPTER 1 OVERVIEW

1.1 Features 1-1

1.2 List of Functions 1-3

CHAPTER 2 COMMON SPECIFICATIONS

2.1 Specifications of RS-485 Communications 2-1

2.1.1 RJ-45 connector (modular jack) specifications 2-3

2.1.2 Terminal block specifications 2-4

2.1.3 Connection cable specifications 2-5

2.2 Connections 2-6

2.2.1 Basic connection 2-6

2.2.2 Connection notes 2-10

2.2.3 Connection devices 2-13

2.2.4 Measures against noise 2-14

2.3 Switching to Communications 2-16

2.3.1 Functions for the switching 2-16

2.3.2 Link functions (Mode selection) 2-17

2.3.3 How to switch communications enabled/disabled 2-18

2.3.4 Loader link functions (Mode selection) 2-19

2.4 Making RS-485-related Settings 2-20

2.4.1 Link function (RS-485 setting) 2-20

2.5 Selecting Data Clear Processing for Communications Error 2-23

CHAPTER 3 Modbus RTU PROTOCOL

3.1 Messages 3-1

3.1.1 Message formats 3-1

3.1.2 Message types 3-1

3.1.3 Message frames 3-2

3.1.4 Message categories 3-4

3.1.5 Communications examples 3-12

3.2 Host Side Procedures 3-13

3.2.1 Inverter's response time 3-13

3.2.2 Timeout processing 3-14

3.2.3 Receiving preparation complete time and message timing from the host 3-15

3.2.4 Frame synchronization method 3-15

3.3 Communications Errors 3-16

3.3.1 Categories of communications errors 3-16

3.3.2 Operations in case of errors 3-17

3.4 CRC-16 3-20

3.4.1 Overview of the CRC-16 3-20

3.4.2 Algorithm 3-20

3.4.3 Calculation example 3-22

3.4.4 Frame length calculation 3-23

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CHAPTER 4 FUJI GENERAL-PURPOSE INVERTER PROTOCOL
4.1 Messages 4-1
4.1.1 Message formats 4-1
4.1.2 Transmission frames 4-2
4.1.3 Descriptions of fields 4-11
4.1.4 Communications examples 4-13
4.2 Host Side Procedures 4-15
4.2.1 Inverter's response time 4-15
4.2.2 Timeout processing 4-16
4.2.3 Receiving preparation complete time and message timing from the host 4-16
4.3 Communications Errors 4-17
4.3.1 Categories of communications errors 4-17
4.3.2 Communications error processing 4-18
CHAPTER 5 FUNCTION CODES AND DATA FORMATS
5.1 Communications Dedicated Function Codes 5-1
5.1.1 About communications dedicated function codes 5-1
5.1.2 Command data 5-2
5.1.3 Monitor data 1 5-11
5.1.4 Information displayed on the keypad 5-16
5.2 Data Formats 5-32
5.2.1 List of data format numbers 5-32
5.2.2 Data format specifications 5-63
CHAPTER 6 Metasys N2 (N2 PROTOCOL)
6.1 Messages 6-1
6.1.1 Communications specifications 6-1
6.1.2 Polling/selecting 6-1
6.2 Setting up the FRENIC-HVAC/AQUA 6-2
6.3 Point Mapping Tables 6-3
6.4 Reading and Writing from/to Function Codes 6-5
6.5 Support Command Lists 6-6
CHAPTER 7 BACnet MS/TP
7.1 Messages 7-1
7.1.1 Communications specifications 7-1
7.2 Setting up the FRENIC-HVAC/AQUA 7-2
7.3 Property Identifiers 7-3
7.4 Binary Point Table 7-4
7.5 Analog Point Table 7-6
7.6 Reading and Writing from/to Function Codes 7-7

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CHAPTER 1
OVERVIEW

This chapter describes the functions that can be realized by performing RS-485 communications.

Table of Contents

1.1 Features 1-1
1.2 List of Functions 1-3

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1.1 Features

The functions listed below can be implemented using RS-485 communications.

- The keypad can be mounted on the easy-to-access front of control panel with an extension cable (option).
- The function code data of the inverter can be edited and the operation status of the inverter can be monitored by connecting it to a personal computer on which inverter support software runs (see the "FRENIC Loader Instruction Manual").
- The inverter can be controlled as a subordinate device (slave) by connecting it to an upper level device (host (master)) such as a PLC or personal computer.

As the communications protocols for controlling inverters, the Modbus RTU widely used by a variety of appliances, and the Fuji general-purpose inverter protocol common to Fuji's inverters are available. In addition, in the FRENIC-HVAC/AQUA, the Metasys N2 and BACnet are also available.

Modbus RTU protocol

The Modbus RTU protocol is a set of communications specifications defined to connect Modicon's PLCs (Programmable Logic Controllers) in a network. A network is established between PLCs or between a PLC and another slave unit(s) (inverter(s), etc.). The main functions include:

- supporting both a query-response format and a broadcast format for messages.
- enabling the host unit as the master to transmit queries to each inverter as a slave, and each slave to send back responses to the queries to the master.
- supporting two modes, RTU mode and ASCII mode, as a transmission mode for the standard Modbus Protocol. The FRENIC series supports the RTU mode only, which provides a high transmission density.
- performing an error check through a CRC (cyclic redundancy check) to ensure accurate data transmission.

Fuji general-purpose inverter protocol

This protocol is commonly used for all models of Fuji's general-purpose inverters. The main functions include:

- enabling, as a common protocol, operation of all models of Fuji's general-purpose inverters with the same host program (function codes cannot be generally edited because specifications are different among models).
- adopting fixed-length transmission frames as standard frames to facilitate developing communications control programs for hosts.
- reducing the communications time in response to operation commands and frequency setting which are required quick response by using optional transmission frames.

Metasys N2 protocol

This protocol is to interface with Metasys systems developed by Johnson Controls. For details about the Metasys N2, refer to the documents issued by Johnson Controls.

BACnet protocol

BACnet refers to the Building Automation and Control Network protocol defined by ASHRAE. It is to interface with systems conforming to BACnet.

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CAUTION

- Since the protocol switches to the keypad dedicated protocol automatically by connecting the keypad, it is not necessary to set up the communications-related functions.
- Although the FRENIC Loader uses a dedicated protocol for loader commands, part of the communications conditions must be set. (For further information, see the "FRENIC Loader Instruction Manual.")

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1.2 List of Functions

The functions listed below become available by operating the appropriate function codes from the host controller.

The chapters that follow describe these functions in detail.

Table 1.1 List of RS-485 communications functions

Function	Description	Related function code
Operation	The functions equivalent to the terminal functions shown below can be executed through communications: - Forward operation command "FWD" and reverse operation command "REV" - Digital input commands ([FWD], [REV], [X1]-[X7] terminals) (The number of X terminals varies with the inverter model.) - Alarm reset command (***RST***)	S codes (dedicated to communica-tions)
Frequency setting	Either of the following three setting methods can be selected: - Set up as "±20000/maximum frequency." - Frequency (in units of 0.01 Hz) without polarity - Rotation speed (in units of 1 min^{-1}) with polarity	
PID command	- Set up as "±20000/100%." Commands to external PID1 to PID3 can be set.	
Clock data	- Year, month, day, hour, minute and second can be set.	
Operation monitor	The items below can be monitored: - Frequency command - Actual values (frequency, current, voltage, etc.) - Operation status, information on general-purpose output terminals, etc.	M codes W codes X codes Z codes (dedicated to communica-tions)
Maintenance monitor	The items below can be monitored: - Cumulative operation time, DC link bus voltage - Information to determine the service life of parts to be periodically replaced (main circuit capacitor, PC board capacitor, cooling fan) - Model codes, capacity codes, ROM version, etc.	
Alarm monitor	The items below can be monitored: - Monitoring alarm history (last nine alarms) - Monitoring information when an alarm occurs (last four alarms) Operation information (output/set frequencies, current, voltage, etc.) Operation status, information on general-purpose output terminals Maintenance information (cumulative operation time, DC link bus voltage, heat sink temperature, etc.)	
Function code	All types of function code data can be monitored and changed.	All function codes other than above

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CHAPTER 2
COMMON SPECIFICATIONS

This chapter describes the specifications common to the Modbus RTU protocol, Fuji general-purpose inverter protocol, Metasys N2, BACnet, and loader protocol. For further information about the specific specifications of each protocol, see Chapter 3 "Modbus RTU Protocol" and Chapter 4 "Fuji General-purpose Inverter Protocol."

Table of Contents

2.1 Specifications of RS-485 Communications 2-1
2.1.1 RJ-45 connector (modular jack) specifications 2-3
2.1.2 Terminal block specifications 2-4
2.1.3 Connection cable specifications 2-5
2.2 Connections 2-6
2.2.1 Basic connection 2-6
2.2.2 Connection notes 2-10
2.2.3 Connection devices 2-13
2.2.4 Measures against noise 2-14
2.3 Switching to Communications 2-16
2.3.1 Functions for the switching 2-16
2.3.2 Link functions (Mode selection) 2-17
2.3.3 How to switch communications enabled/disabled 2-18
2.3.4 Loader link functions (Mode selection) 2-19
2.4 Making RS-485-related Settings 2-20
2.4.1 Link function (RS-485 setting) 2-20
2.5 Selecting Data Clear Processing for Communications Error 2-23

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2.1 Specifications of RS-485 Communications

Table 2.1 shows the specifications of RS-485 communications.

Table 2.1 RS-485 communications specifications

Item	Specification		
Protocol	FGI-BUS	Modbus RTU	Loader commands
Complying with	Fuji general-purpose inverter protocol	Modicon Modbus RTU-compliant (only in RTU mode only)	Special commands dedicated to inverter support loader software (not disclosed)
No. of supporting stations	Host device: 1 Inverters: up to 31		
Physical level	EIA /RS-485		
Connection to RS-485	Connect using the RJ-45 connector or terminal block		
Synchronization method of character	Start-Stop system		
Transmission mode	Half-duplex		
Transmission speed (bps)	2400, 4800, 9600, 19200 and 38400		
Maximum transmission cable length	500 m		
No. of available station addresses	1 to 31	1 to 247	1 to 255
Message frame format	FGI-BUS	Modbus RTU	Loader command
Synchronization method of transmission frames	Detection SOH (Start Of Header) character (SOH 01_H)	Detection of no-data transmission time for 3 byte period	Start code 96H detection
Frame length	Normal transmission: 16 bytes (fixed) High-speed transmission: 8 or 12 bytes	Variable length	Variable length
Maximum transfer data	Write: 1 word Read: 1 word	Write: 50 words Read: 50 words	Write: 41 words Read: 41 words
Messaging system	Polling/Selecting/Broadcast		Command message
Transmission character format	ASCII	Binary	Binary
Character length	8 or 7 bits (selectable by the function code)	8 bits (fixed)	8 bits (fixed)
Parity	Even, Odd, or None (selectable by the function code)		Even
Stop bit length	1 or 2 bits (selectable by the function code)	No parity: 2 bits Even or Odd parity: 1 bit	1 bit (fixed)
Error checking	Checksum	CRC-16	Checksum

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Table 2.1 RS-485 communications specifications (continued)

Item	Specification	
Protocol	Metasys N2	BACnet
Complying with	Metasys N2 developed by Johnson Controls	ANSI/ASHRAE Standard 135-1995
No. of supporting stations	Host device: 1 Inverters: up to 31	
Physical level	EIA RS-485	
Connection to RS-485	Connect using the RJ-45 connector or terminal block	
Synchronization method of character	Start-Stop system	
Transmission mode	Half-duplex	
Bus topology	Master-Slave	Master-Slave/Token Passing (MS/TP)
Maximum transmission speed	9600 bps	9600, 19200 and 38400 bps
Maximum transmission cable length	500 m	
No. of available station addresses	1 to 255	0 to 127
Message frame format	Metasys N2	BACnet
Synchronization method of transmission frames	Timing-synchronization	
Frame length	Variable	501 octets max.
Messaging system	Polling/Selecting/Broadcast	
Transmission character format	ASCII, 7 bits fixed	
Character length	8 bits (fixed)	
Parity	No parity (fixed)	
Stop bit length	1 bit (fixed)	
Error checking	Checksum	CRC

Table 2.2 Connection method and applicable protocol for FRENIC series

Model	Communi-cations means	Connection port	Hardware specifications for connection port	Port type	Applicable protocol *1					
					Keypad *2	Loader	Modbus RTU	Fuji general-purpose inverter protocol	Metasys N2	BACnet
FRENIC-HVAC/ AQUA	Keypad connection connector on inverter unit	RJ-45 connector	See Section 2.1.1.	Standard port	√	√	√	√	√	√
	Control circuit terminal block on inverter unit	Terminal block	See Section 2.1.2.	Extension port	--	√	√	√	√	√

*1 Metasys N2 or BACnet cannot operate both the standard and extension ports at the same time.

*2 Only the dedicated keypad can be connected to the FRENIC-HVAC/AQUA.

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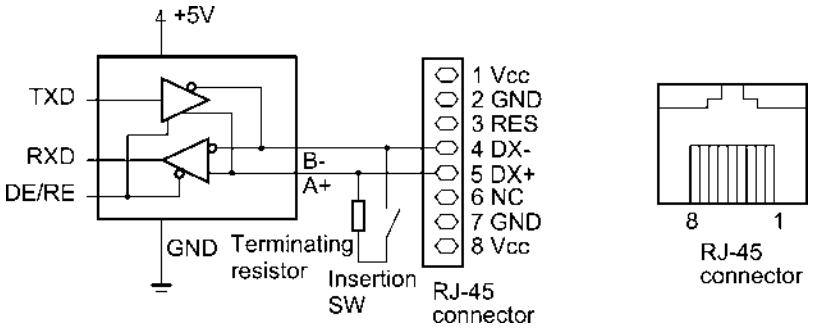
2.1.1 RJ-45 connector (modular jack) specifications

The table below lists the pin assignment of the RJ-45 connector (modular jack, designed for keypad connection).

Pin No.	Signal name	Function	Remarks
1, 8	Vcc	Power source for the keypad	5V
2, 7	GND	Reference voltage level	Ground (0 V)
3	RES	Reserved (Connect nothing to this pin.)	–
6	NC	No connection	–
4	DX-	RS-485 communications data (-)	A terminating resistor of 112Ω is incorporated. Connection/cut off is selected by a switch*1.
5	DX+	RS-485 communications data (+)	

*1 For the details of the terminating resistor insertion switch, refer to Section 2.2.2 "Connection notes, [2] "About terminating resistors."



⚠CAUTION

- The RJ-45 connector has the pins connected to the keypad power supply (pins 1, 2, 3, 7 and 8). When connecting the inverter with a device such as other inverters via a communications cable, take care not to connect the wiring of the device to those pins assigned to the power supply. Connect nothing to pin 3.
- When the inverter is connected with the FVR-E11S series, a power short-circuit or a collision of signal lines may occur, resulting in a damaged inverter. For details, refer to Section 2.2.2 "Connection notes."

Failure may result.

2.1.2 Terminal block specifications

The terminal for RS-485 communications port 2 is provided in the control circuit terminals of the inverter. The table below shows the code, name, and function of each terminal. These terminals can be easily connected with the multi-drop circuit.

Terminal symbol	Terminal name	Function description
DX+	RS-485 communications data (+) terminal	--
DX-	RS-485 communications data (-) terminal	--
SD	Communications cable shield terminal	This is the terminal for relaying the shield of the shielded cable, insulated from other circuits.
Internal switch	Terminating resistor switching	A terminating resistor of 112Ω is incorporated. Connection/release is switched by this switch*.

* For details of the terminating resistor insertion switch, see Section 2.2.2 "Connection notes, [2] About terminating resistors."

2.1.3 Connection cable specifications

[1] RJ-45 connector

The specification of the connection cable is as follows to ensure the reliability of connection.

	Specifications
Common specifications	Straight cable for 10BASE-T/100BASE-TX, satisfying the US ANSI/TIA/EIA-568A category 5 standard (commercial LAN cable)
Extension cable for remote operations (CB-5S)	Same as above, 8-core, 5 m long, RJ-45 connector (both ends)
Extension cable for remote operations (CB-3S)	Same as above, 8-core, 3 m long, RJ-45 connector (both ends)
Extension cable for remote operations (CB-1S)	Same as above, 8-core, 1 m long, RJ-45 connector (both ends)

To connect a keypad, use an 8-core straight cable. Use an extension cable for remote operations (CB-5S, CB-3S, or CB-1S) or a commercial LAN cable (20m max.).

Recommended LAN cable

Maker: Sanwa Supply (JAPAN)

Type: KB-10T5-01K (1 m)

KB-STP-01K (1-m shielded cable: Compliant with EMC Directives)

[2] Cable specifications for connection with terminals

To secure the reliability in connection, use the twisted pair shielded cable AWG16 to 26 for long-distance transmission.

Recommended cable

Maker: Furukawa Electric's AWM2789 long-distance cable

Type(Product code): DC23225-2PB

2.2 Connections

2.2.1 Basic connection

When connecting the keypad with the inverter or connecting the inverter with a host such as personal computer or PLC, use a standard LAN cable (straight for 10BASE-T). A converter is necessary to connect a host not equipped with RS-485 interface.

(1) Connection with the keypad

The figure below shows the method of connecting the keypad to the keypad connector of the inverter.

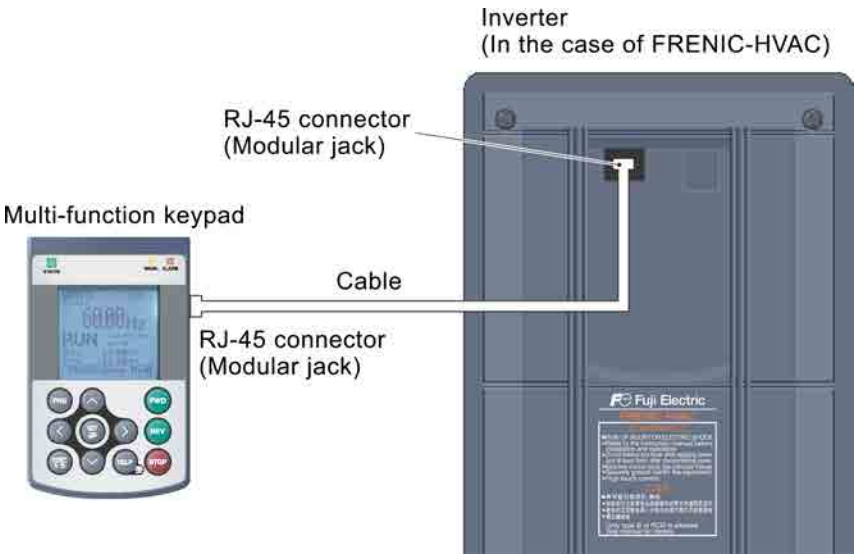


Figure 2.1 Connection with the keypad

Cable: Extension cable for remote operations (CB-5S, CB-3S, or CB-1S) or commercial LAN cable

CAUTION
- For the keypad, be sure to turn off the terminating resistor.
- Keep wiring length 20 m or less.

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(2) Connection with the inverter support software FRENIC Loader (computer) (when connecting with the USB port via a recommended converter)

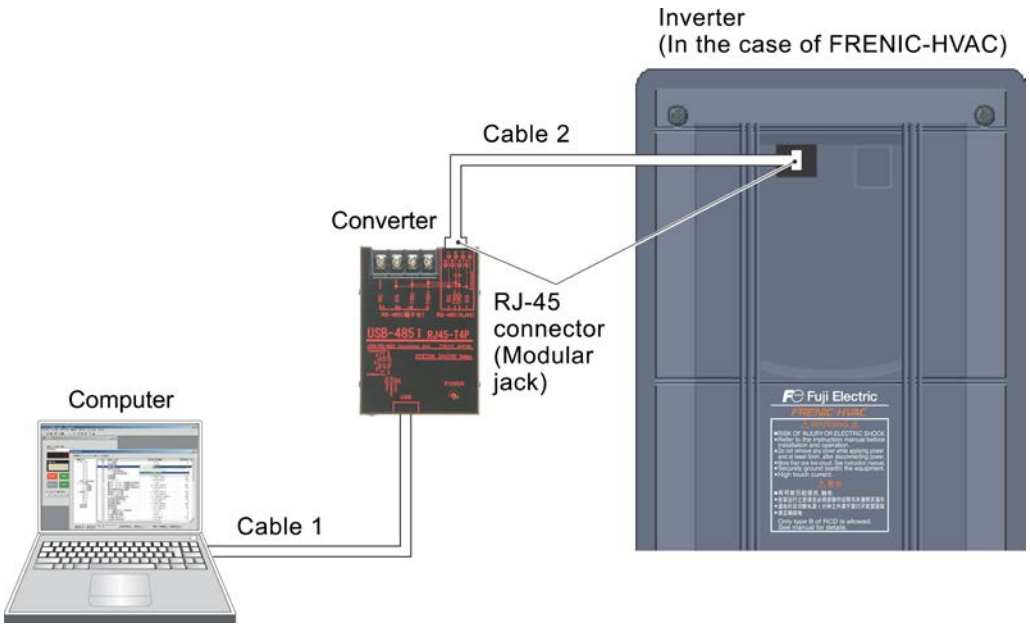

Figure 2.2 Connection with a computer

Converter: USB-485I, RJ45-T4P (Refer to Section 2.2.3 "Connection devices.")

Cable 1: USB cable supplied with the converter

Cable 2: extension cable for remote operations (CB-5S, CB-3S, or CB-1S) or commercial LAN cable

The inverter can be also connected with FRENIC Loader using the USB port provided on the inverter's control circuit board.

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(3) Connection 1 to host (Multi-drop connection using the RJ-45 connector)

The figure below shows a connecting example to the multi-drop circuit with RJ-45 connector. RJ-45 needs a multi-drop branch adaptor as an external device for relaying. The adaptor for relaying is not necessary for the inverter with RJ-45 connector for function expansion. Turn ON the terminating resistor insertion switch on the terminating inverter. For details about insertion switch ON/OFF, see Section 2.2.2 "Connection notes, [2] About terminating resistors."

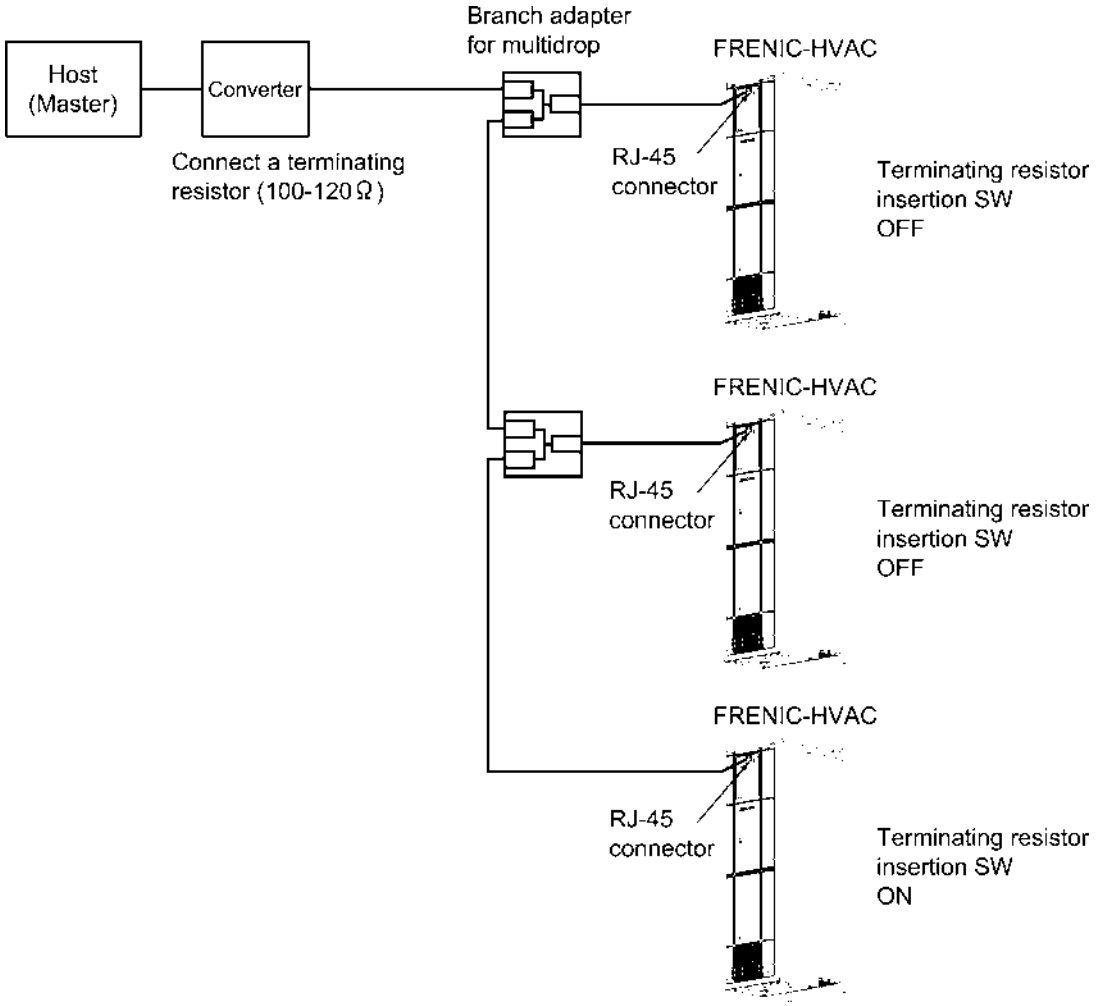

Figure 2.3 Multidrop connection diagram (connection via the RJ-45 connector)

Converter:	Not necessary if the host is equipped with RS-485 interface.
Branch adapter for multidrop:	Useful when implementing 1:n multidrop configuration using a cable with a RJ-45 connector.
Cable:	Use a connection cable meeting the specifications.

CAUTION

- The RJ-45 connector has the pins connected to the keypad power supply (pins 1, 2, 3, 7 and 8). When connecting the inverter with a device such as other inverters via a communications cable, take care not to connect the wiring of the device to those pins assigned to the power supply. Use signal lines (pins 4 and 5) only.
- When selecting additional devices to prevent the damage or malfunction of the control PCB caused by external noises or eliminate the influence of common mode noises, be sure to see Section 2.2.3 "Connection devices."
- Keep the total wiring length 500 m max.

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(4) Connection 2 to host (Multi-drop connection using terminal block)

The figure below shows a connecting example to the multi-drop circuit with the terminal block. Turn on the terminating resistor insertion switch on the terminating inverter.

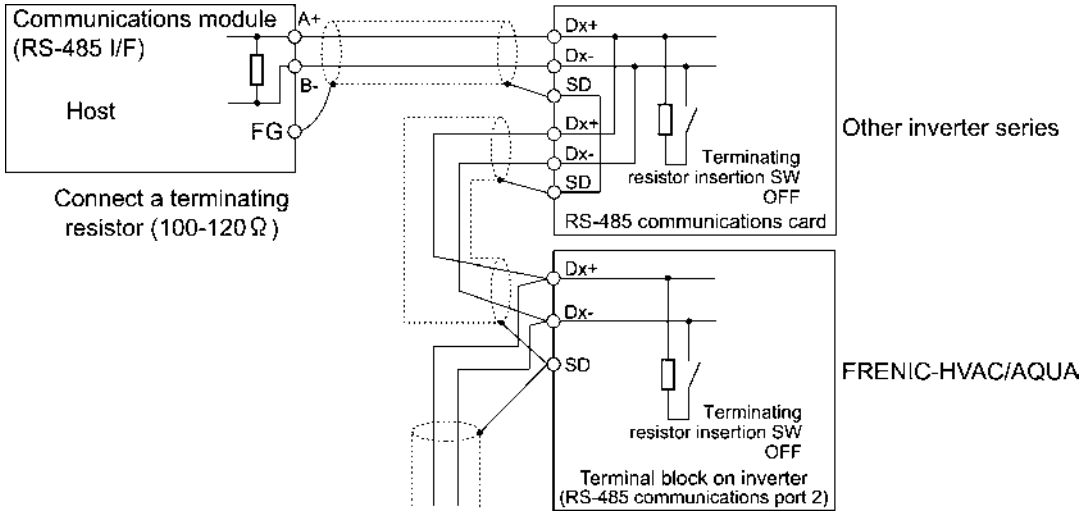

Figure 2.4 Multidrop connection diagram (terminal block connection)

For the switch used to insert the terminal resistance, refer to Section 2.2.2 "Connection notes, [2] About terminating resistors."

CAUTION
- When selecting additional devices to prevent the damage or malfunction of the control PCB caused by external noises or eliminate the influence of common mode noises, be sure to see Section 2.2.3 "Connection devices."
- Keep the total wiring length 500 m max.

2.2.2 Connection notes

This section describes the knowledge necessary for connecting with a host.

[1] RJ-45 connector (modular jack) pin layout

To facilitate connection with a standard device, the RJ-45 connector (for keypad connection) on the inverter unit has two pairs of pin arrays conforming to the 4-pair arrangement. DX- and DX+ signals are assigned to pins 4 and 5, respectively.

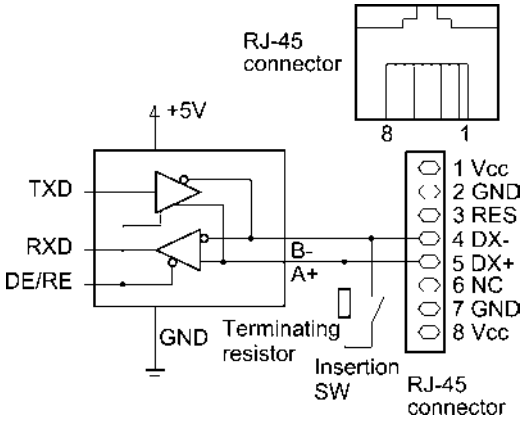

Figure 2.5 Pin layout of RJ-45 connector

CAUTION

- The RJ-45 connector has the pins connected to the keypad power supply (pins 1, 2, 7 and 8) and a reserved pin (pin 3). When connecting the inverter with a device such as other inverters via a communications cable, take care not to connect the wiring of the device to those pins assigned to the power supply. Use signal lines (pins 4 and 5) only.
- To connect the FRENIC series of inverters to the same communications network on which the FVR-E11S series exists, pins 3 to 5 must be changed using a connection cable, etc. Table 2.3 makes a comparison of pin layouts between the FRENIC series and the FVR-E11S series.

⚠CAUTION

- The RJ-45 connector has the pins connected to the keypad power supply (pins 1, 2, 3, 7 and 8). When connecting the inverter with a device such as other inverters via a communications cable, take care not to connect the wiring of the device to those pins assigned to the power supply.
- If the communications circuit is connected with FVR-E11S series, there is a possibility that the power circuit is shorted or the signal wires collide with each other, resulting in the damage to the circuit. For details, see Section 2.2.2 "Connection notes."

Failure may occur.

Table 2.3 Comparison of pin layout between the FRENIC series and the FVR-E11S series

Pin No.	FRENIC series inverter unit	FVR-E11S series	Remarks
1	VCC (+5V)	SEL_TP (keypad selected)	The power supply is short-circuited when connected.
2	GND	GND	
3	RES	DX-	
4	DX-	DX+	
5	DX+	SEL_ANY (optional)	
6	NC	GND	
7	GND	VCC	The power supply is short-circuited when connected.
8	VCC (+5V)	VCC	The power supply is short-circuited when connected.

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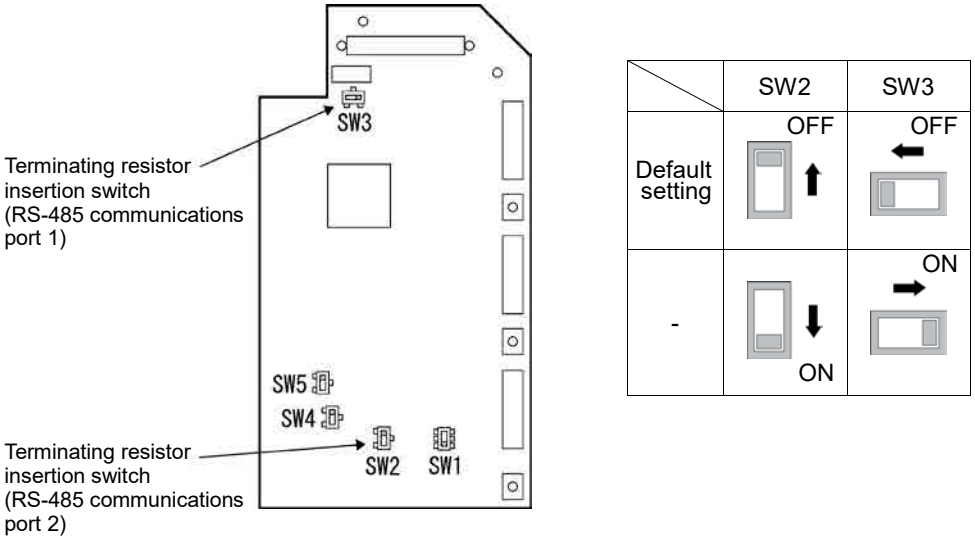
[2] About terminating resistors

Insert a terminating resistor (100 to 120Ω) into both ends of the connection cable. This allows controlling signal reflection and reducing noises.

Be sure to insert a terminating resistor into the terminating host side and the side of the device connected to the final stage, in short, both the terminating devices configuring the network. Terminating resistors are inserted into total two positions. Note that the current capacity of signals may be insufficient if terminating resistors are inserted into three or more devices.

If the inverter is used as a terminating device, turn ON the terminating resistor insertion switch.

Objective printed circuit board	Switch No.	Use	Layout
Control printed circuit board in the inverter unit	SW2	RS-485 communications port 1 (RJ-45 connector)	See Figure 2.6.
	SW3	RS-485 communications port 2 (Terminal block)	



Printed circuit board

Figure 2.6 Location and configuration of terminating resistor insertion switches

[3] Connection with a four-wire host

Although the inverter uses two-wire cables, some hosts adopt only four-wire cables. Connect to such a host by connecting the driver output with the receiver input with a crossover cable on the host side to change the wiring method to two-wire.

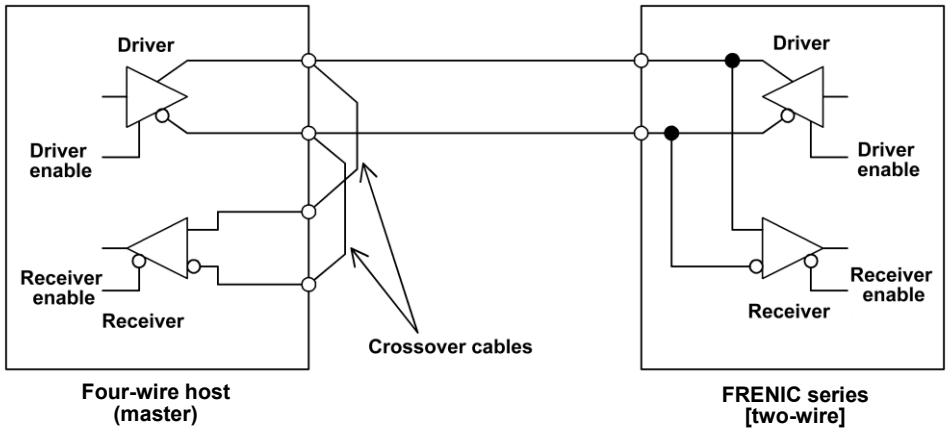


Figure 2.7 Connection with a four-wire host

CAUTION

- The driver circuit on the host side must have a function to set the driver output to high impedance (driver enable: OFF). Though products conforming to RS-485 normally have this function, check the specifications of the host.
- Keep the output of the driver circuit on the host side in the status of high impedance except when the host is transmitting data (driver enable: OFF).
- Keep the receiver circuit of the host device deactivated (receiver enable: OFF) while the host is transmitting data to prevent the host from receiving the data it transmitted. If the receiver cannot be deactivated, program the host so that the data transmitted by the host is discarded.

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2.2.3 Connection devices

This section describes the devices necessary for connecting a host not equipped with RS-485 interface, such as a computer, or for multidrop connection.

[1] Converter

In general, personal computers are not equipped with an RS-485 port. An RS-232C to RS-485 converter or USB to RS-485 converter is therefore required. Use a converter meeting the following recommended specifications for proper operation. Note that proper performance may not be expected from a converter other than the recommended one.

Specifications of the recommended converter

Transmission/receiving switching system: Automatic switching by monitoring transmission data on the personal computer side (RS-232C)
Isolation: The RS-232C side of the converter must be isolated from the RS-485 side.
Failsafe: Equipped with a failsafe function (*1)
Other requirements: The converter must have enough noise immunity for successful communications.

*1 The failsafe function means a function that keeps the RS-485 receiver's output at high logic level even when the RS-485 receiver's input is open or short-circuited or when all the RS-485 drivers are inactive.

Recommended converter

System Sacom Sales Corporation (Japan) : KS-485PTI (RS-232C to RS-485 converter)
: USB-485I RJ45-T4P (USB to RS-485 converter)

Transmission/receiving switching system

Since RS-485 communications adopts the half-duplex system (two-wire system), the converter must have a transmission/receiving switching function. The following two systems are available as the switching system.

(1) Automatic turnaround of the transceiver buffer
(2) Switching with the flow control signal (RTS or DTR) from the personal computer

In the case of FRENIC Loader, the operating system released before Microsoft Windows98 or an older version does not support the switching system described in (2) above. Use the converter described in (1).

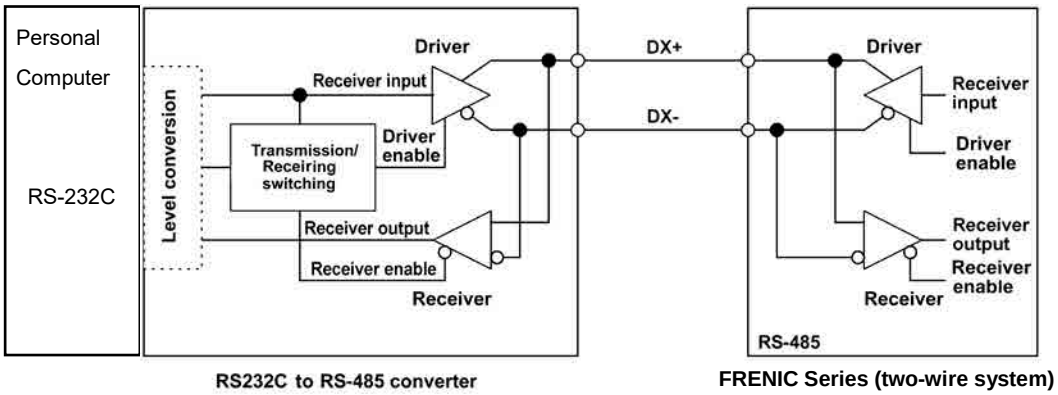

Figure 2.8 Communications level conversion

[2] Branch adapter for multidrop

The inverter uses an RJ-45 connector (modular jack) as a communications connector. For multi-drop connection using a LAN cable having an RJ-45 connector, a branch adaptor is required.

Recommended branch adapter

SK Kohki (Japan): MS8-BA-JJJ

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2.2.4 Measures against noise

Depending on the operating environment, normal communications cannot be performed or instruments and converters on the host side may malfunction due to the noise generated by the inverter. This section describes measures to be taken against such problems. Consult Appendix A "Advantageous Use of Inverters (Notes on electrical noise)" in the FRENIC-HVAC/AQUA User's Manual.

[1] Measures for devices subjected to noise

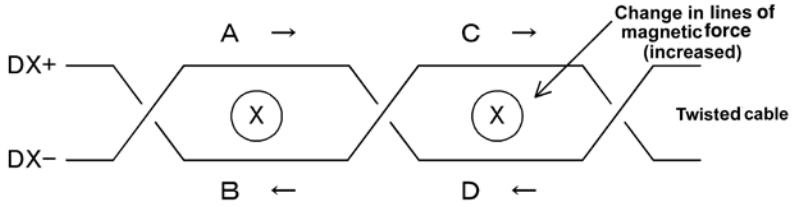
Using an isolated converter

An isolated converter suppresses common mode noise that exceeds the specified operating voltage range of the receiver in case of long-distance wiring. However, since the isolated converter itself may malfunction, use a converter insusceptible to noise.

Using a category 5 compliant LAN cable

Category 5 compliant LAN cables are generally used for RS-485 communications wiring. To obtain an improved preventive effect on electromagnetically induced noise, use Category 5 conformed LAN cables with four twisted-pair-cores and apply one twisted pair, DX+ and DX-. To ensure a high preventive effect on electrostatically induced noise, use Category 5 conformed LAN cables with four shielded-and-twisted-pair-cores, and ground the shield at the master-side end.

Effect of twisted pair cables



A uniform magnetic flux directing from the face to back of the paper exists, and if it increases, electromotive force in the direction of → is generated. The electromotive forces of A to D are the same in intensity, and their directions are as shown in the above figure. In the cable DX+, the direction of electromotive forces B is reverse to that of electromotive force C, then the electromotive forces B and C offset each other, and so do electromotive forces A and D in the cable DX-. So, normal mode noise caused by electromagnetic induction does not occur. However, noise cannot be completely suppressed under such conditions as an uneven twist pitch. In the case of twisted cables, the normal mode noise is considerably reduced. But in the case of parallel cables, there may be a case where noises are not sufficiently reduced.

Shield effect

1) When the shield is not grounded,
   the shield functions as an antenna and receives noise.
2) When the shield is grounded at both ends,
   if the grounding points are separated from each other, the ground potential may be different between them, and the shield and the ground form a loop circuit in which a current flows and may cause noise. Additionally, the magnetic flux within the loop may vary and generate noise.
3) When the shield is grounded at either end,
   the effect of electrostatic induction can be completely eliminated within the shielded section.

Connecting terminating resistors

Insert a resistor equivalent to the characteristic impedance of the cables (100 to 120Ω) into both end terminals of the wiring (network) to prevent ringing due to the reflection of signals.

Separating the wiring

Separate the power lines (input L1/R, L2/S, and L3/T and output U, V, and W) from the RS-485 communications line, because induced noise can be prevented.

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Separating the grounding

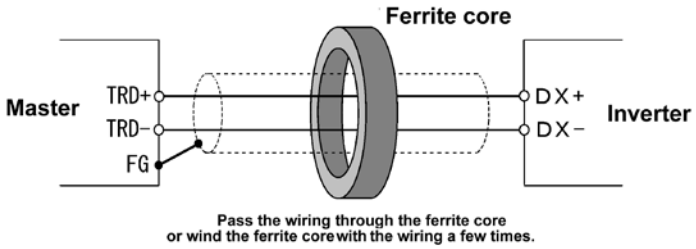
Do not ground instruments and the inverter together. Noise may conduct through the grounding wire. Use as a thick wire as possible for grounding.

Isolating the power supply

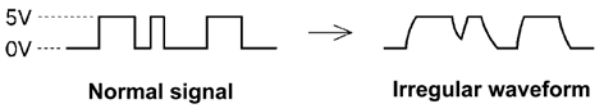
Noise may carry through the power supply line to instruments. It is recommended that the distribution system be separated or a power isolation transformer (TRAFY) or noise suppression transformer be used to isolate the power supply for such instruments from the power supply for the inverter.

Adding inductance

Insert a chalk coil in series in the signal circuit, or pass the signal wiring through a ferrite core, as shown in the figure below. This provides the wiring higher impedance against high-frequency noise, and suppresses the propagation of high-frequency noise.



CAUTION If an inductance is added, the signal waveform may become irregular and a transmission error may result during communications at a high baud rate. In this case, reduce the baud rate by changing the setting of function code y04.



[2] Measures against noise sources

Reducing carrier frequency

By lowering data of function code F26 "motor sound (carrier frequency)," the noise level can be reduced. However, reducing the carrier frequency increases the motor sound.

Installing and wiring an inverter

Passing the power lines through metal conduit or adopting metal control panels can suppress radiation or induction noise.

Isolating the power supply

Using a power isolation transformer on the line side of the inverter can cut off the propagation (transmission) of noise.

[3] Additional measures to reduce the noise level

Consider using a zero-phase reactor or EMC compliance filter. The measures described in [1] and [2] above can generally prevent noise. However, if the noise does not decrease to the permissible level, consider additional measures to reduce the noise level. For details, see the User's Manual of each inverter model. (Refer to the FRENIC-HVAC/AQUA User's Manual, Chapter 4, Section 4.4.1.)

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2.3 Switching to Communications

2.3.1 Functions for the switching

Figure 2.9 below shows a block diagram via communications for frequency setting and run commands.

This block diagram indicates only the base of the switching section, and some settings may be given higher priority than the blocks shown in this diagram or details may be different due to functional expansion and so on. For details, refer to the FRENIC-HVAC/AQUA User's Manual.

CAUTION Run commands herein include digital input signals via the communications link.

The setting of function code H30 (Communications link function (Mode selection)) selects the command system to be applied when the communications link is valid.

Assigning the terminal command "Enable communications link" (***LE***)" to a digital input and disabling the communications link (***LE*** = OFF) switches the command system from the communications link to other settings such as digital input from the terminal block.

In short, the frequency setting, run forward command, and X1 signal in Figure 2.9 switch from communications dedicated function codes S01, S05, and S06 to terminals [12], [FWD], and [X1], respectively.

Function code data can be read and written through the communications link regardless of the setting of H30 (Communications link function (Mode selection)).

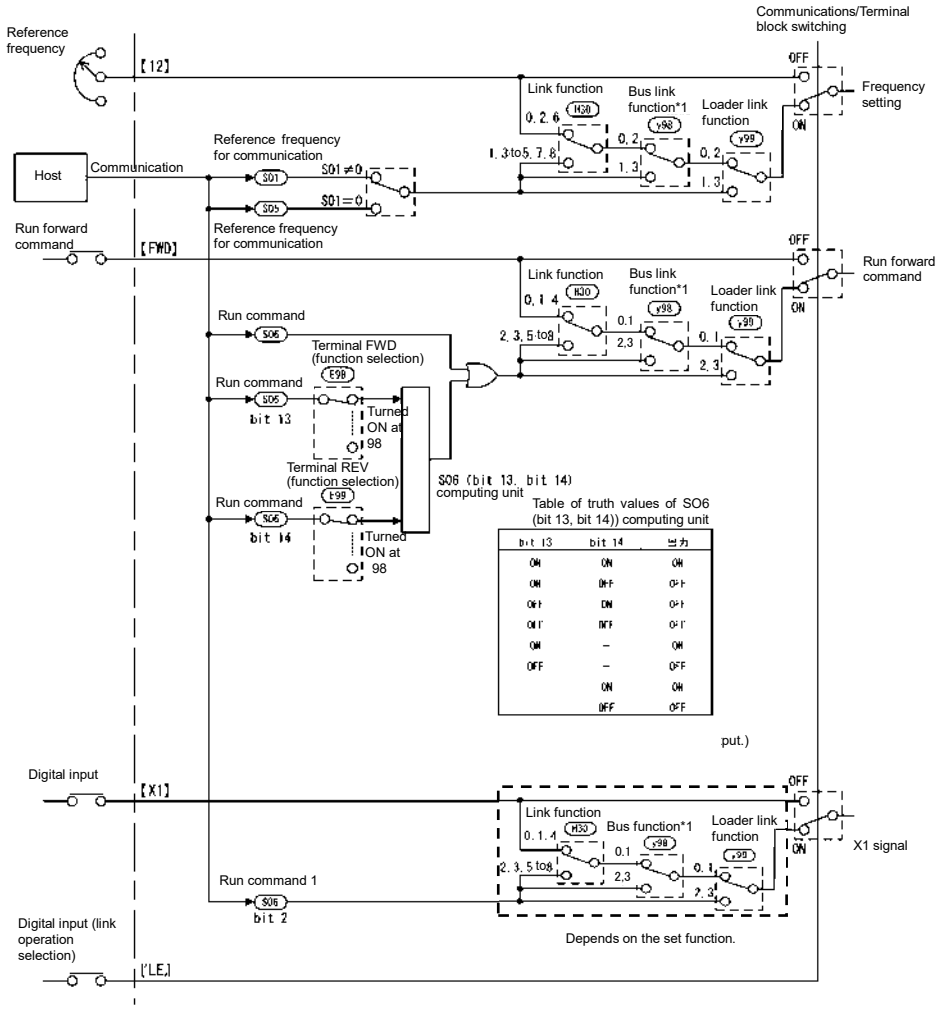

Figure 2.9 Command block diagram via communications

2.3.2 Link functions (Mode selection)

The setting of function code H30 (Communications link function, Mode selection) selects the frequency command and run command sources (via communications link or from the terminal block) to be applied when the communications link is enabled.

The setting is influenced by the settings of y98 and y99. For details, see Figure 2.9.

Table 2.4 Communications link function H30 (Mode selection)

Data for H30 (Communications link function)	When the communications link is enabled:	
	Frequency command	Run command
0	Inverter unit	Inverter unit
1	RS-485 communication (RJ-45)	Inverter unit
2	Inverter unit	RS-485 communication (RJ-45)
3	RS-485 communication (RJ-45)	RS-485 communication (RJ-45)
4	RS-485 communication (Port 2)	Inverter unit
5	RS-485 communication (Port 2)	RS-485 communication (RJ-45)
6	Inverter unit	RS-485 communication (Port 2)
7	RS-485 communication (RJ-45)	RS-485 communication (Port 2)
8	RS-485 communication (Port 2)	RS-485 communication (Port 2)

By selecting continuous communications valid without setting any digital input terminal, and switching the data of H30 to communications valid/invalid (external signal input valid), communications valid/invalid can be switched in the same manner as switching at the digital input terminal. See the next section or later.

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2.3.3 How to switch communications enabled/disabled

To issue a frequency setting or operation command through communications to control the inverter, select "Through RS-485 communications" by function code H30: link function (operation selection).

In addition, when switching control through communications with control from the terminal block (frequency setting from terminal [12], operation command from terminal [FWD] and so on) to switch remote operations with operations on the inverter body, assign "link operation selection" (data = 24: "LE") to the function code related to the digital input terminal (one of E01-E05: terminals [X1] to [X5], E98: terminal [FWD], or E99: terminal [REV]). Control can be switched by the terminal to which "link operation selection" (data = 24: "LE") is assigned.

Communications automatically becomes valid when link operation selection is not assigned to any digital input terminal.

Table 2.5 Digital input terminal settings and communications statuses

Input terminal	Status
OFF	Communications invalid
ON (short-circuited to the terminal [CM])	Communications valid

- Via-communications command data and operation data must be rewritten from the host (controller) because the memory is initialized when the power is turned ON.
- Although command data and operation data can be written even if communications is invalid, they will not be validated because the switch is made invalid by link operation selection. If communications is made valid with no operation data written (operation command OFF, frequency setting = 0 Hz) during operation, the running motor decelerates to a stop and may exert impact on the load depending on the set deceleration time. Operation can be switched without causing impact to the load by setting data in communications invalid mode in advance and then switching the mode to valid.
- If negative logic is set as Link enable (data 1024), the logical value corresponding to the ON/OFF status of the command "LE" will be reversed.
- The field bus option is handled prior to RS-485 communication depending on the setting of the option in some cases. For details, see the function code y98 "Bus link function (Mode selection)."

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2.3.4 Loader link functions (Mode selection)

The setting of function code y99 (Loader link function, Mode selection) selects the frequency command and run command sources (via communications link or as specified with H30 and y98) to be applied when the communications link is enabled.

- Function code y99 is designed for inverter support software such as FRENIC Loader, and forcibly makes communications valid without changing the setting of H30. Do not change the current setting unless otherwise required.
- The data of this function code cannot be saved in the inverter and will return to "0" when the power is turned off.

Table 2.6 Loader link functions

Data for y99 (Loader link function)	When the communications link is enabled:	
	Frequency command	Run command
0	Follow H30 and y98 data	Follow H30 and y98 data
1	Via communications link (S01, S05)	
2	Follow H30 and y98 data	Via communications link (S06)
3	Via communications link (S01, S05)	

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2.4 Making RS-485-related Settings

2.4.1 Link function (RS-485 setting)

Use function codes (y01 to y10 and y11 to y20) to make settings for RS-485 communications functions. y01 to y10 are for port 1 and y11 to y20, for port 2.

Station address (y01, y11)

Set a station address for RS-485 communications. The setting range depends on the protocol.

Table 2.7 RS-485 setting (station addresses)

Protocol	Range	Broadcast
Modbus RTU protocol	1 to 247	0
Protocol for loader commands	1 to 255	–
Fuji general-purpose inverter protocol	1 to 31	99
Metasys N2	1 to 255	–
BACnet	1 to 127	255

- No response is expected if an address number out of the specified range is set.
- Match the station address with that of the personal computer when FRENIC Loader is connected.

Operation made selection when an error occurs (y02, y12)

Set the operation performed when an RS-485 communications error occurs.

RS-485 communications errors are logical errors such as an address error, parity error, or framing error, transmission error, and communications disconnection error set by y08 and y18. In any case, error is detected only while the inverter is running in the link operation made for both the operation command and frequency setting. If neither the operation command nor frequency setting is sent through RS-485 communications or the inverter is not running, error is ignored.

Table 2.8 RS-485 setting (operations when an error has occurred)

y02, y12 data	Function
0	Indicates an RS-485 communications error (Er8 for port 1 and ErP for port 2), and stops operation immediately (alarm stop).
1	Runs during the time set on the error processing timer (y03, y13), and then displays an RS-485 communications error (Er8 for port 1 and ErP for port 2) and stops operation (alarm stop).
2	Runs during the time set on the error processing timer (y03, y13). If communications are recovered, continues operation. Otherwise, displays an RS-485 communications error (Er8 for port 1 and ErP for port 2) and stops operation (alarm stop).
3	Continues operation even after a communications error has occurred.

Timer for y02 and y12 (y03, y13)

Set a timer for error detection.

It is judged as an error that the response to a request is not received within time set because of no response of the other end and so on. See the section of "Communications disconnection detection time (y08, y18)."

- Data input range: 0.0 to 60.0 (s)

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Baud rate (y04, y14)

Set a baud rate.

- Setting when FRENIC Loader is connected
  Match the baud rate with that of the computer.

Table 2.9 Baud rate

Data	Baud rate
0	2400 bps
1	4800 bps
2	9600 bps
3	19200 bps
4	38400 bps

Data length (y05, y15)

Set a character length.

- Setting when FRENIC Loader is connected
  This code does not need to be set because it is automatically set to eight bits (as in the Modbus RTU protocol).

Table 2.10 Data length

Data	Function
0	8 bits
1	7 bits

Parity check (y06, y16)

Set a parity bit.

- Setting when FRENIC Loader is connected
  This code does not need to be set because it is automatically set to even parity.

Table 2.11 Parity check

Data	Function	RTU Stop bits (auto setting)
0	No parity bit	2 bits
1	Even parity	1 bit
2	Odd parity	1 bit
3	No parity bit	1 bit

Stop bits (y07, y17)

Set a stop bit.

- Setting when FRENIC Loader is connected
  This code does not need to be set because it is automatically set to 1.

- In the Modbus RTU protocol, this code does not need to be set because it is automatically determined in conjunction with the parity bit.

Table 2.12 Stop bits

Data	Function
0	2 bits
1	1 bit

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No response error detection time (y08, y18)

In a system designed to be sure to access a station (inverter) managed by a host within a specific period of time, access may be lost during RS-485 communications due to wire disconnections. In such a case, the inverter starts the operation of communications error set up by y02 and y12 if the inverter detects the symptom and access is still lost even after the communications disconnection detection time has passed.

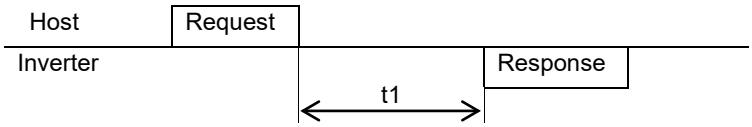
Table 2.13 No response error detection time

Data	Function
0	No response error detection disabled
1 to 60	Detecting time from 1 to 60 seconds

Response interval (y09, y19)

Set the time from the completion of receipt of a request from the host, to the return of response to it. Even in a slow processing device, timing can be adjusted by changing the response interval time.

- Data setting range: 0.00 to 1.00 (second)



t1 = Response interval time + α

α: The processing time within the inverter. It depends on the timing and command given.
For further information, see the procedure for each protocol on the host below:
Modbus RTU protocol → Chapter 3, Section 3.2 "Host Side Procedures"
Fuji general-purpose inverter protocol → Chapter 4, Section 4.2 "Host Side Procedures"

- Setting when FRENIC Loader is connected
  Set the response interval time according to the performance and conditions of the computer and converter (RS-232C−RS-485 converter, etc.).
  (Some converters monitor the communications status and use a timer to switch transmission/receiving.)

Protocol selection (y10, y20)

Select a communications protocol.

- Setting when FRENIC Loader is connected.
  Select the protocol for FRENIC Loader commands.

Table 2.14 Protocol selection

Data	Protocol
0	Modbus RTU
1	Protocol for Loader commands
2	Fuji general-purpose inverter protocol
3	Metasys N2
5	BACnet
50	Pump control (communications link) (FRENIC-AQUA: y20 only)

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2.5 Selecting Data Clear Processing for Communications Error

Use function code y95

If the inverter causes an alarm due to a communications error* (including a bus link error), it can zero-clear communication commands stored in the memory as specified by y95.

*Object errors: Er8, ErP, Er4, Er5 and ErU

Data for y95	Function
0	Do not clear the data of function codes Sxx when a communications error occurs. (compatible with the conventional inverters)
1	Clear the data of function codes S01, S05 and S19 when a communications error occurs.
2	Clear the run command-assigned bit of function code S06 when a communications error occurs.
3	Clear both data of S01, S05 and S19 and run command-assigned bit of S06 when a communications error occurs.

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CHAPTER 3

Modbus RTU PROTOCOL

This chapter describes the Modbus RTU protocol, as well as the host side procedure for using this protocol and error processing.

The Modbus RTU protocol was a set of specifications developed in the United States. In this chapter, the terms in the specifications are accompanied by English ones as much as possible.

Table of Contents

3.1 Messages 3-1
3.1.1 Message formats 3-1
3.1.2 Message types 3-1
3.1.3 Message frames 3-2
3.1.4 Message categories 3-4
3.1.5 Communications examples 3-12
3.2 Host Side Procedures 3-13
3.2.1 Inverter's response time 3-13
3.2.2 Timeout processing 3-14
3.2.3 Receiving preparation complete time and message timing from the host 3-15
3.2.4 Frame synchronization method 3-15
3.3 Communications Errors 3-16
3.3.1 Categories of communications errors 3-16
3.3.2 Operations in case of errors 3-17
3.4 CRC-16 3-20
3.4.1 Overview of the CRC-16 3-20
3.4.2 Algorithm 3-20
3.4.3 Calculation example 3-22
3.4.4 Frame length calculation 3-23

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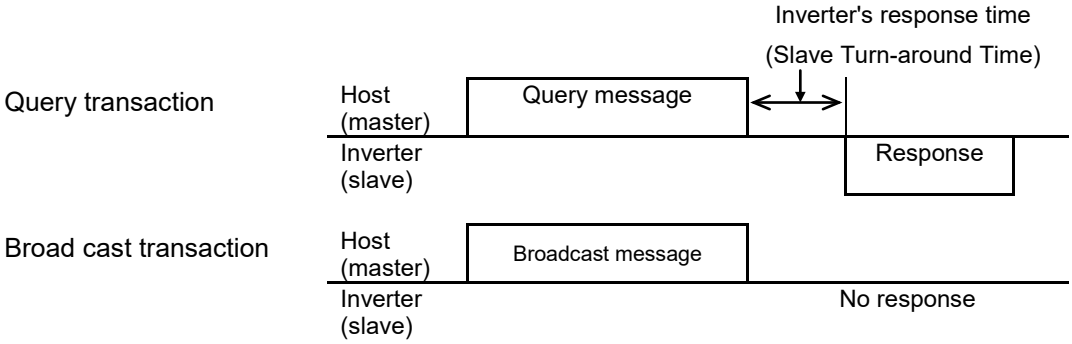
3.1 Messages

3.1.1 Message formats

The regular formats for transmitting RTU messages are shown below:



If the inverter receives from the host a message in the standby status and considers it properly received, it executes a transaction in response to the request and sends back normal response.
If the inverter judges that the message has not been received properly, it returns error response.
The inverter does not send back any response in the case of broadcast transactions.

3.1.2 Message types

Message types are classified into four types; query, normal response, error response, and broadcast.

Query

The host sends messages to an inverter.

Normal response

After the inverter received a query from the host, the inverter executes a transaction in response to the request, and sends back corresponding normal response.

Error response

If the inverter receives a query but cannot execute the requested function because an invalid function code is specified or for other reasons, it sends back error response.
The error response is accompanied by a message describing the reason the request cannot be executed.
The inverter cannot send back any response in case of a CRC or physical transmission error (parity error, framing error, overrun error).

Broadcast

The host uses address 0 to send messages to all slaves. All slaves, which receive a broadcast message, execute the requested function. This transaction will be terminated upon timeout of the host.
In broadcast communication, only S01, S05, S06, S13, S14, S19, S31 to S33, and S90 to S93 can be selected from the standard frame.

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3.1.3 Message frames

As shown below, a transmission frame consists of four blocks, which are called fields. Details depend on FC (RTU function codes). To make a clear distinction between RTU function codes and the inverter's function codes, the former will be hereinafter referred to as 'FC'.

1 byte	1 byte	Up to 105 bytes	2 bytes
Station address	FC (RTU function code)	Information	Error check

Station address

The station address field is one byte long, in which a station address between 0 and 247 can be selected.
Selecting address 0 means the selection of all slave stations and a broadcast message.

'FC' (RTU function code)

The 'FC' field is one byte long, in which a function code is defined with a number from 0 to 255. The 'FCs' in the shaded rows are available. Do not use any unavailable (unused) 'FC'. Failure to observe this rule results in error response.

Table 3-1 List of 'FC'

'FC'	Description
0	Unused
1	Read Coil Status (80 coils maximum)
2	Unused
3	Read Holding Registers (50 registers maximum)
4	Unused
5	Force Single Coil
6	Preset Single Register
7	Unused
8	Diagnostics
9 to 14	Unused
15	Force Multiple Coils (16 coils maximum)
16	Preset Multiple Registers (50 registers maximum*1)
17 to 127	Unused
128 to 255	Reserved for exception response

Information

The information field contains all information (function code, byte count, number of data, data, etc.). For further information about the information field for each message type (broadcast, query, normal response, error response), see Section 3.1.4 "Message categories."

Error check

The error check field is a CRC-16 check system and two bytes long. Since the length of the information field is variable, the frame length required for calculating the CRC-16 code is calculated based on the 'FC' and the byte count data.

For further information about CRC-16 calculations and algorithm, see Section 3.4 "CRC-16."

For byte counts, see Section 3.1.4 "Message categories."

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Character format

Each byte of a message is transmitted as a character. Character formats are described on the following page.
A character comprises a start bit (logical value 0), 8-bit data, an additional (optional) parity bit, and a stop bit (logical value 1).

A character always consists of eleven bits, and the number of stop bits varies depending on whether parity exists.

Without parity

LSB MSB

0	1	2	3	4	5	6	7	8	9	10
Start	Data								Stop	

With parity

LSB MSB

0	1	2	3	4	5	6	7	8	9	10
Start	Data								Parity (optional)	Stop

- Modbus RTU protocol has the above character format as specified by the rule. But, some devices use the format "No parity + 1 stop bit." For connection with these devices, the inverter supports the parity bit selection (y06=3, y16=3). When y06=3 or y16=3, the protocol is given the following character format.

LSB MSB

0	1	2	3	4	5	6	7	8	9
Start	Data								Stop

3.1.4 Message categories

There are eight RTU message categories; read holding registers, preset single register, preset multiple registers, diagnostics, read coil status, force single coil, force multiple coils and error response.
Each category is described below:

[1] Read holding registers

Query

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	03_H	Function code	Number of read data	Error check
		Hi Lo	Hi Lo	

Normal response

1 byte	1 byte	1 byte	2 to 100 bytes	2 bytes
Station address	03_H	Byte count	Read data	Error check
			Hi, Lo (data 0); Hi, Lo (data 1); ·····	

How to set a query

- This request is not available for broadcast transactions. Station address 0 will become invalid (no response).
- 'FC' = 3 (03_H)
- The function code is two bytes long. The Hi byte indicates the function code group (see Table 3.2), and the Lo byte represents a function code identification number (0 to 99).

  (Example) When the function code is E15, the Hi byte is 01_H and the Lo byte is $0F_H$.
- Each function code of the inverter is assigned to the holding register areas (40000 to 49999). The address of each function code can be calculated with the following expression. (The same applies also to "presetting single register" and "presetting multiple registers.")

  Address calculation expression

  40000 + (Code in Table 3.2) x 256 + Function code number

  (Example) In the case of J60

J	60
↓	↓
13	60

The holding register address of function code J60 =
40000 + (Code in Table 3.2: 13) x 256 + Function code number 60 = 43388

Table 3.2 Function code group/code conversion table

Group	Code		Name	Group	Code		Name
F	0	00_H	Fundamental functions	M	8	08_H	Monitor data
E	1	01_H	Extension terminal functions	J	13	$0D_H$	Application functions 1
C	2	02_H	Control functions	d	19	13_H	Application functions 2
P	3	03_H	Motor 1 parameters	U	11	$0B_H$	Application functions 3
H	4	04_H	High performance functions	L	9	09_H	Reserved.
A	5	05_H	Reserved.	y	14	$0E_H$	Link functions
b	18	12_H	Reserved.	W	15	$0F_H$	Monitor 2
r	10	$0A_H$	Reserved.	X	16	10_H	Alarm 1
S	7	07_H	Command/Function data	Z	17	11_H	Alarm 2
o	6	06_H	Operational functions	J1	48	30_H	Application functions
W1	22	16_H	Monitor 3	J2	49	31_H	Application functions
W2	23	17_H	Monitor 4	J3	50	32_H	Reserved.
W3	24	18_H	Monitor 5	J4	51	33_H	Application functions
X1	25	19_H	Alarm 3	J5	52	34_H	Application functions
K	28	$1A_H$	Keypad functions	J6	53	35_H	Application functions
T	29	$1B_H$	Timer functions	K1	206	CE_H	Reserved.
H1	31	$1F_H$	High performance functions 1	K2	207	CF_H	Reserved.
U1	39	27_H	Customizable logic functions				

- The length of the read data is up to 50 words (2 byte each).
- If the read data contains an unused function code, 0 will be read, which will not result in an error.
- Data does not extend over two or more function code groups. If, for example, reading of 40 words is specified from F40 but only function codes up to F40 are available, the data of F40 will be set at the first word, and the other 49 words will be 0.

Interpretation of normal response

- The data range of byte counts is between 2 and 100. A byte count is double the number of read data (1 - 50 data) of the response.
- The read data contains each word data in order of Hi byte and Lo byte, and each word data is sent back in order of the data of the function code (address) requested by the query, the data of that address number plus 1, the data of that number address number plus 2 ... If two or more function data are read and the second or any of the following data contains an unused function code (F19, etc.), the read data will become 0.

[2] Preset single register

Query

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	06_H	Function code	Write data	Error check
		Hi Lo	Hi Lo	

Normal response

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	06_H	Function code	Write data	Error check

How to set a query

- When address 0 is selected, broadcast is available. In this case, all inverters do not respond even if a broadcast request is executed.
- 'FC' = 6 (06_H)
- The function code is two bytes long. The Hi byte indicates the function code group (see Table 3.2), and the Lo byte represents a function code identification number (0 to 99).
- The written data field is fixed two bytes long. Set the data on the function code to be written.

Interpretation of normal response

The frame is the same as the query.

[3] Preset multiple registers

Query

1 byte	1 byte	2 bytes	2 bytes	1 byte	2 to 100 bytes	2 bytes
Station address	10_H	Function code	Number of write data	Byte count	Write data	Error check
		Hi Lo	Hi Lo		Hi, Lo; Hi, Lo…	

Normal response

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	10_H	Function code	Number of write data	Error check

How to set a query

- When the station address 0 is selected, broadcast is available. In this case, all inverters do not respond even if a broadcast request is executed.
- 'FC' = 16 (10_H)
- The function code is two bytes long. The Hi byte indicates the function code group (see Table 3.2), and the Lo byte represents a function code identification number (0 to 99).
- The number of write data is two bytes long, and the setting range is from 1 to 50. If 51 or a higher value is set, error response will result.
- The byte count field is one byte long, and the setting range is from 2 to 100. Set a value equivalent to the double of the number of write data.
- Set the lowest order code (the data on the function code requested by the query) at the first two bytes of the write data, and the higher order data (address plus 1, address plus 2 ...) at the following bytes.
- If the write data contains an unused function code, the writing will be ignored, which will not result in an error.

Interpretation of normal response

- With regard to the function code and the number of write data, the same values as those of the query will be sent back.

[4] Diagnostics

Query

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	08_H	Sub function code 0000_H	Write data	Error check
		Hi Lo	Hi Lo	

Normal response

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	08_H	Sub function code 0000_H	Write data	Error check

How to set a query

- This request cannot use broadcast. Station address 0 will become invalid (no response).
- 'FC' = 8 (08_H)
- Set the sub function code field to be 2 bytes long fixed 0000_H. Error response will result if data other than 0000_H is set.
- The write data field is two bytes long, and any contents of data can be set.

Interpretation of normal response

- The frame is the same as the query.

[5] Read coil status

Query

1 byte	1 byte	2 bytes		2 bytes		2 bytes
Station address	01_H	Coil address		No. of coils		Error check
		Hi	Lo	Hi	Lo	

Normal response

1 byte	1 byte	1 byte	1 to 10 bytes	2 bytes
Station address	01_H	Byte count	Read data	Error check

How to set a query

- Broadcast with station address 0 is not usable. If this address is used, no response is returned.
- 'FC'=1 (01_H)
- Read out a coil (bit data) by specifying the top address of the coil to be read out and the number of points read out (number of coils).
- For the assignment of a coil (bit data), see Table 3.3. For each content, refer to the S and M codes in the remarks column.

Table 3.3 Description of coil (bit data)

Coil number	+7	+6	+5	+4	+3	+2	+1	+0	Remarks
1	X6	X5	X4	X3	X2	X1	REV	FWD	S06: Run operation command (Read/Write)
9	RST	XR	XF	–	–	–	–	X7	
17	VL	TL	NUV	BRK	INT	EXT	REV	FWD	M14: Run status (Read only)
25	BUSY	WR		RL	ALM	DEC	ACC	IL	
33	FAN	KP	OL	IPF	SWM2	RDY	FDT	FAR	M70: Run status 2 (Read only)
41	–	–	IDL	ID	OPL	LIFE	OH	TRY	
49	X6	X5	X4	X3	X2	X1	REV	FWD	M13: Run operation command (final command) (Read only)
57	RST	XR	XF	–	–	–	–	X7	
65	–	–	–	Y5	Y4	Y3	Y2	Y1	M15: General-purpose output terminal information (Read only)
73	–	–	–	–	–	–	–	30	

- The "–" symbols in the table mean that the bit is reserved and always zero.
- Coil addresses are 0 to 79, calculated by subtracting one from coil numbers. If a coil address is 80 or more, an error occurs because of an incorrect address.
- The number of coils is 1 to 80. If the number of coils exceeds the range, an error occurs because of an incorrect address.
- No error occurs even if the sum of the numbers of coil addresses and coils exceeds the coil range.

Interpretation of normal response

- Data are stored from the LSB (the rightmost bit in the table above) in ascending order of coil number. When a coil is turned on, the data becomes one, and all the remaining bits are changed to zero.
- The byte length of the read data is filled in the byte count field.
- For a data example, see Table 3.4.

Table 3.4 Example of coil address = 13 and the number of coils = 9

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data's 1st byte	BRK	INT	EXT	REV	FWD	RST	XR	XF
Data's 2nd byte	0	0	0	0	0	0	0	NUV

[6] Force single coil

Query

1 byte	1 byte	2 bytes		2 bytes		2 bytes
Station address	05_H	Coil address		Data		Error check
		Hi	Lo	Hi	Lo	

Normal response

1 byte	1 byte	2 bytes	2 bytes	2 bytes
Station address	05_H	Coil address	Data	Error check

How to set a query

- Broadcast with station address 0 is not usable. If used, no response is returned.
- 'FC' = 5 (05_H)
- Turn on/off a coil (bit data) by specifying only a bit.
- For the assignment of a coil (bit data), see Table 3.5. For each content, refer to the S and M codes in the remarks column.

Table 3.5 Description of coil (bit data)

Coil number	+7	+6	+5	+4	+3	+2	+1	+0	Remarks
1	X6	X5	X4	X3	X2	X1	REV	FWD	S06: Run operation command (Read/Write)
9	RST	XR	XF	–	–	–	–	X7	

- The "–" symbol in the table means that the bit is reserved, and writing is ignored.
- The coil address is 0 to 15, calculated by subtracting one from the coil number. If a coil address is 16 or more, an error occurs because of an incorrect address.
- When a coil is turned off, data are 0000_H. When a coil is turned on, data are $FF00_H$.

Interpretation of normal response

- The format of normal response is the same as that of inquiry.
- No response is returned to the broadcast command.

[7] Force multiple coils

Query

1 byte	1 byte	2 bytes		2 bytes		1 byte	1 to 2 bytes		2 bytes
Station address	$0F_H$	Coil address		No. of coils		Byte account	Write data		Error check
		Hi	Lo	Hi	Lo		Hi	Lo	

Normal response

1 byte	1 byte	2 bytes		2 bytes		2 bytes
Station address	$0F_H$	Coil address		No. of coils		Error check
		Hi	Lo	Hi	Lo	

How to set a query

- Broadcast with station address 0 is not usable. If is used, no response is returned.
- 'FC' = 15 ($0F_H$)
- Write a coil (bit data) by specifying the top address of the coil to be written, the number of points written (number of coils), and data to be written.
- For the assignment of a coil (bit data), see Table 3.6. For each content, refer to the S and M codes in the remarks column.

Table 3.6 Description of coil (bit data)

Coil number	+7	+6	+5	+4	+3	+2	+1	+0	Remarks
1	X6	X5	X4	X3	X2	X1	REV	FWD	S06: Run operation command (Read/Write)
9	RST	XR	XF	–	–	–	–	X7	

- The "-" symbol in the table means that the bit is reserved and always zero.
- The coil address is 0 to 15, calculated by subtracting one from the coil number. If a coil address is 16 or more, an error occurs because of an incorrect address.
- If the byte count is 0 or 3 or more, an error occurs because of an incorrect data.
- The number of coils is 1 to 16. If 0 or 17 or more, an error occurs because of an incorrect address.
- No error occurs even if the coil address plus number of coils exceeds the coil range.
- If the number of coils is 9 or more and the byte count is 1 or less, an error occurs because of an incorrect data.
- If the number of coils is 8 or less and the byte count is 2, no error occurs.
- Data are stored from the LSB (the rightmost bit in the table above) in ascending order of coil number. When a coil is turned on, the data becomes one. When a coil is turned off, the data becomes zero. All the remaining bits are ignored.
- The byte count field indicates the byte length of the write data.
- For a data example, see Table 3.7.

Table 3.7 Example of coil address = 2 and the number of coils = 9

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data's 1st byte	0	X7	X6	X5	X4	X3	X2	X1
Data's 2nd byte	0	0	0	0	0	0	0	0

Interpretation of normal response

- The forms of coil address and number of coils are the same as the forms of query.
- No response is returned to the broadcast command.

[8] Error response

If the inverter receives an improper query, it will not execute it, which will result in error response.

Error response

1 byte	1 byte	1 byte	2 bytes
Station address	Exception function	Subcode	Error check

Interpretation of error response

- The station address is the same as that of the query.
- The exception function is a value obtained by adding 80_H to the 'FC' of the query message (or the value of the 'FC' if the 'FC' is larger than 80_H).
  For example, when the 'FC' is 3, the exception function is 3 + 128 = 131 (83_H).
- The subcode represents the code of the reason for the improper query.

Table 3.8 Subcodes

Subcode	Item		Description	Order of priority
1	Improper 'FC'		The inverter received an unsupported FC. (See Table 3.1.)	1
2	Improper address	Improper function code	An unused function code or a function code out of range was received. When the read/write data (except the first one) containing an unused function code. - During function reading Zero (0) will be read, which will not result in an error. - During continuous function writing The writing will be ignored, which will not result in an error.	2
		Improper number of data	- When the number of read/write data is not between 1 and 50. - No error will result when the value of the function code plus the number of data is beyond the setting range of the function code.	
		Diagnostic code error (maintena-nce code)	A value other than 0 was received although the sub code as the diagnostics was fixed to 0.	
3	Improper data	Data range error	The write data is beyond the permissible write range.	3*1
7	NAK	No right of writing	No right of writing by H30/y98/y99	
		Write disable	- Writing was attempted to the functions to which writing from RTU is prohibited or to which writing is disabled during operation. - Writing was attempted to a function code (other than S01, S05, S06, S13, S14, S19, S31 to S33, and S90 to S93) that could not be written when the voltage was insufficient.	

*1 The priority between sub code 3 and 7 depending on a cause of sub code 7.

- If response is sent back to an improper query, a subcode will be set in an error code (that can be referred to with M26).

3.1.5 Communications examples

Typical communications examples are shown below (the station address is 5 in all cases).

(Example 1) M06: Reading actual frequency and speed

Query (host ⇒ inverter)

05	03	08	06	00	01	67	EF

Normal response (inverter ⇒ host)

05	03	02	27	10	A3	B8

The detected speed value is 2710_H, or 10000_d. The actual frequency is 30 Hz according to the expression shown below:

$$10000 \times \frac{\text{Maximum frequency}}{20000} = 30\ (\text{Hz})$$ (Maximum frequency: 60 Hz)

(Example 2) S01: The value of 15 Hz will be written to frequency command (maximum frequency: 60 Hz).

According to the expression shown below, the value to be written is 1388_H.

$$15\ \text{Hz} \times \frac{20000}{60\ (\text{Hz})} = 5000_d = 1388_H$$

Query (host ⇒ inverter)

05	06	07	01	13	88	D5	AC

Normal response (inverter ⇒ host)

05	06	07	01	13	88	D5	AC

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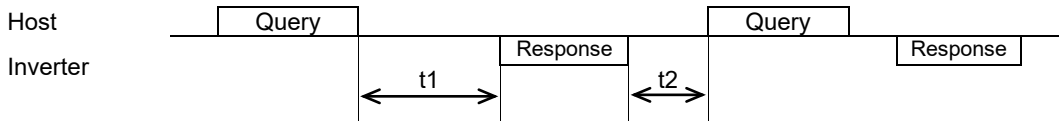
3.2 Host Side Procedures

3.2.1 Inverter's response time

Upon receipt of a query from the host, the inverter executes the queried transaction and sends back response after the response time shown below:



t1: Response interval time

The response interval time is the longest time out of the time setting by a function code(1), 3-character time(2), or inverter's processing time(3).

(1) y09/y19: setting of response interval time
0.00-1.00(s), factory shipment setting: 0.01(s)
You can set the time from receiving a request issued from a host to starting to send a response. By setting a response interval time, even the host side which is slower than the inverter can meet timing.

(2) 3-character time (maximum value)

Table 3.9 3-character time (maximum time)

Baud rate (bps)	2400	4800	9600	19200	38400
3-character time (ms)	15	10	5	5	5

(3) Inverter processing time (The data volume shown below indicates the number of words.)
1) Read holding registers, read coil status, multiple read holding registers

Table 3.10 Inverter processing time

Data count	Inverter processing time (minimum to maximum)
1 to 7	5 to 10 (ms)
8 to 16	10 to 15 (ms)
n	Int ((n-1)/8)×5 to int ((n-1)/ 8)×5+5 (ms)

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2) Preset single register, preset multiple registers, force single coil, and force multiple coils

Table 3.11 Inverter processing time

Data count	Inverter processing time (minimum to maximum)
1	25 to 30 (ms)
2	45 to 50 (ms)
3	65 to 70 (ms)
4	85 to 90 (ms)
n	n×20+5 to n×20+10 (ms)

If the data is written in H03=1, the inverter processing time is a maximum of 5 seconds. If the data is written in H03=2 or in P02, the processing time is a maximum of 500 (ms).

3) Maintenance code: 10 (ms)

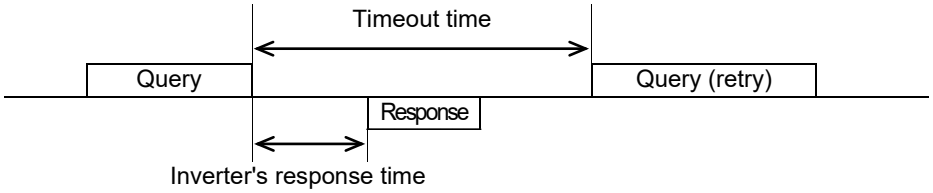
t2: Receiving preparation time

See Section 3.2.3 "Receiving preparation complete time and message timing from the host."

3.2.2 Timeout processing

To read/write data from/to the host, transmit the next frame after confirming response. If response is not transmitted from the inverter for more than a specified period of time (timeout time), it is a timeout, and perform a retry. (If a retry begins before a timeout time elapses, the requested frame cannot be received properly.)

The timeout time must be set longer than the response time of the inverter. In case of a timeout, retransmit the same frame or read details of the error (M26) to confirm whether the inverter sends back normal response. If normal response is returned, this indicates that some transient transmission error occurred due to noise or for other reasons, and subsequent communications is normal. (However, if this phenomenon frequently occurs even when normal response is sent back, some problem may exist. Perform a close investigation.) In case of no response, perform another retry. If the number of retries exceeds the set value (generally about three times), there may be a problem with the hardware and the software of the host. Investigate and correct the cause.



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3.2.3 Receiving preparation complete time and message timing from the host

The time from the return of response by the inverter until the completion of receiving preparation of the communications port (switching from transmission to receiving) is called a receiving preparation complete time.

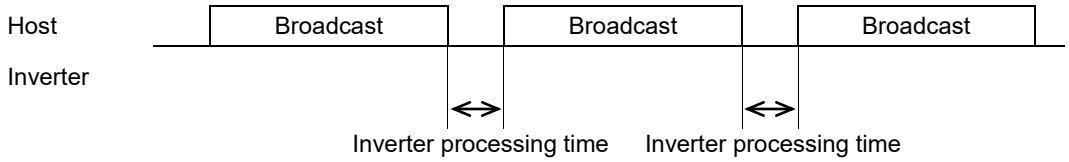
Transmit the following messages after the receiving preparation complete time:

Receiving preparation complete time: 3-character time

In the case of broadcast

Upon receipt of a query message from the host by broadcast, the inverter executes the query and enters the receiving enabled status.

When sending a message from the host after broadcast is performed, send the message after the inverter processing time shown in Section 3.2.1 "Inverter response time" has passed.

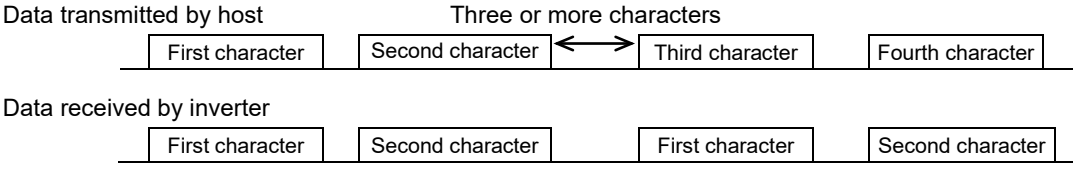


3.2.4 Frame synchronization method

Since the RTU transmits and receives binary data without using header characters for frame synchronization, a frame synchronization system is defined as a time without data to identify the head of the frame.

If data communications does not occur for a period equal to three characters (33 bits including the start and stop bits) at the current transmission speed during receiving standby, initialize the frame information, and consider the first received data the first byte of the frame. If a character interval reaches the length of three characters or more while a frame is received, the frame is discarded.

For this reason, the host must transmit data at a time interval of three or less characters between two characters.



With regard to data to another station, messages from the host and response from that station will be received. In response transmission to identify the head of the frame, a waiting time of three characters (33 bits including the start and stop bits) is required between the completion of data receipt by the station and the start of transmission.

Any devices multidropped also requires such a waiting time.

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3.3 Communications Errors

3.3.1 Categories of communications errors

The communications-related errors the inverter detects are listed below:

Table 3.12 Communications errors detected by inverter

Error category	Error name	Description	Error code (M26 or M67)
Logical error	Improper 'FC'	See "Table 3.8 Subcodes" shown in 3.1.4 [8].	1 (01_H)
	Improper address		2 (02_H)
	Improper data		3 (03_H)
	NAK		7 (07_H)
Transmission error	CRC error	The frame to the local station is found unmatched in CRC collation.	71 (47_H)
	Parity error	The parity is unmatched.	72 (48_H)
	Other errors	Receiving errors other than the abovementioned (framing error, overrun error)	73 (49_H)
Communica-tions disconnection error	Communications disconnection error	The inverter did not receive a normal frame addressed to local or to other stations within the communications disconnection time set with the function code.	—

Logical error (error codes 1 to 7)

When a logical error is detected, an error response frame reports it. For further information, see "3.1.4 [8] Error response."

Transmission error (error codes 71 to 73)

When a transmission error occurs eight straight times, it is handled as a communications error. However, the inverter does not return response in order to avoid overlapping of response from multiple inverters. The count of eight straight times will be cleared upon normal receipt of a frame to another station or to the local inverter (station) itself.

Communications disconnection error

If the inverter in operation does not receive a normal frame to itself or to other stations when it has received a normal frame more than once and is operating via communications (frequency command or operation command), this status is considered disconnected.

If the status of disconnection continues for the communications disconnection time set up by function code (y08, y18), error processing is performed as a communications error.

1) Communications disconnection detection time (y08, y18): 0 (without detection), 1 to 60 (seconds)

2) Condition to clear communications disconnection detection timer:
   It will be cleared in a status other than disconnection.

When it is necessary to take action against errors by factor, the factor can be identified by reading M26 or M67. (M26 or M67 stores the latest communications error codes.)

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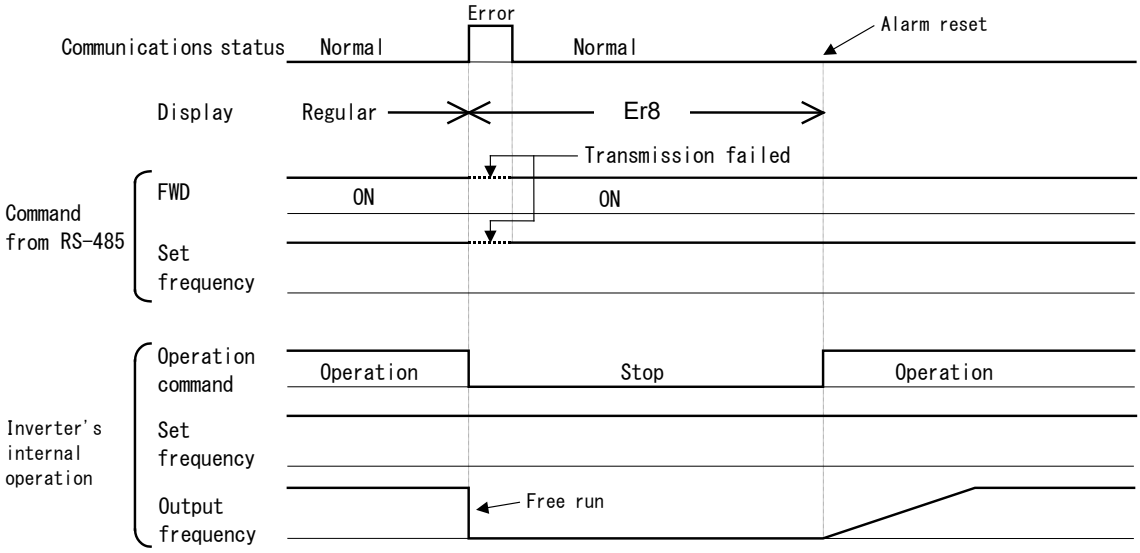
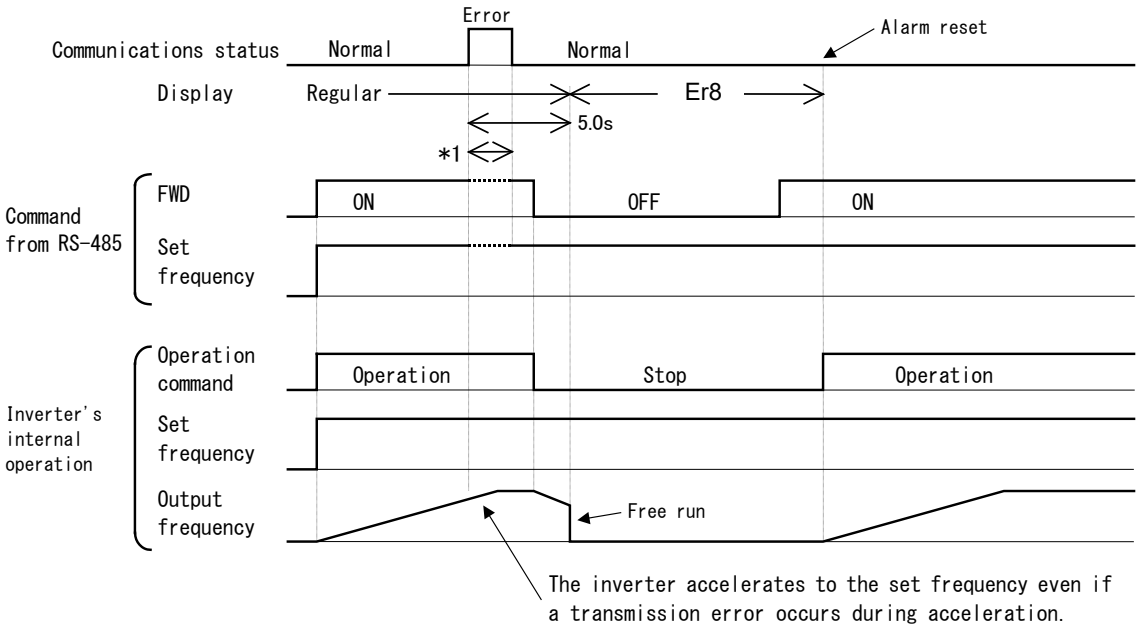
3.3.2 Operations in case of errors

The action when a transmission or communications disconnection error occurs can be selected with function code y02, y12. (For further information, see Section 2.4 "Making RS-485-related settings.")
This section shows specific examples of action by different settings of function code y02. (The same operation is performed for y12 as well. In this case, the y02 and y03 in the figure are replaced with y12 and y13, and the error indication becomes ErP.

When y02 = 0 (mode in which the inverter is forced to immediately stop in case of communications error)



When y02 = 1 and y03 = 5.0 (seconds) (mode in which the inverter is forced to stop five seconds after a communications error occurred)



*1 For the period until communications is recovered, the command (command data, operation data) executed just before the communications error had occurred is retained.

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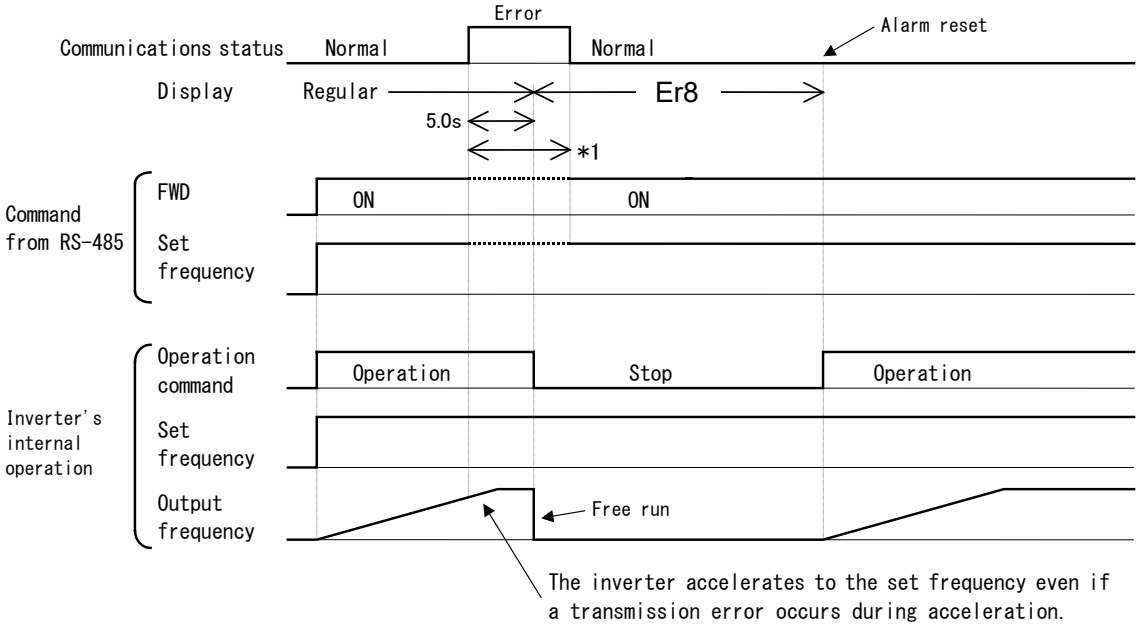
When y02 = 2 and y03 = 5.0 (seconds)

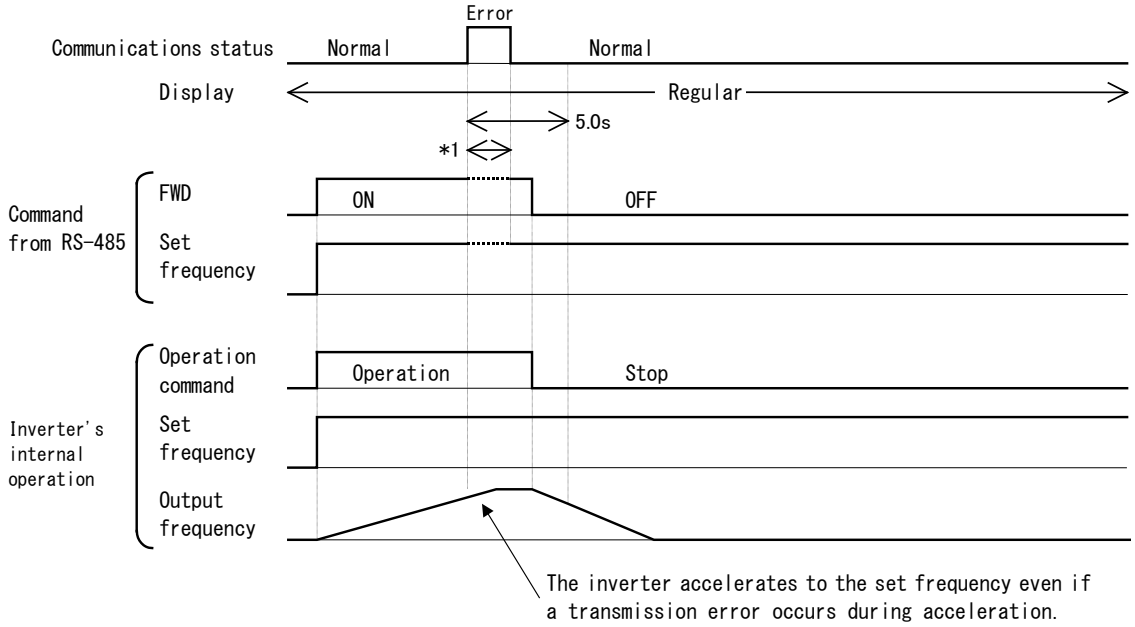
(when communications is not recovered although five seconds elapsed from the occurrence of a communications error, and an Er8 trip occurs)



*1 For the period until communications is recovered, the command (command data, operation data) executed just before the communications error had occurred is retained.

When y02 = 2 and y03 = 5.0 (seconds)

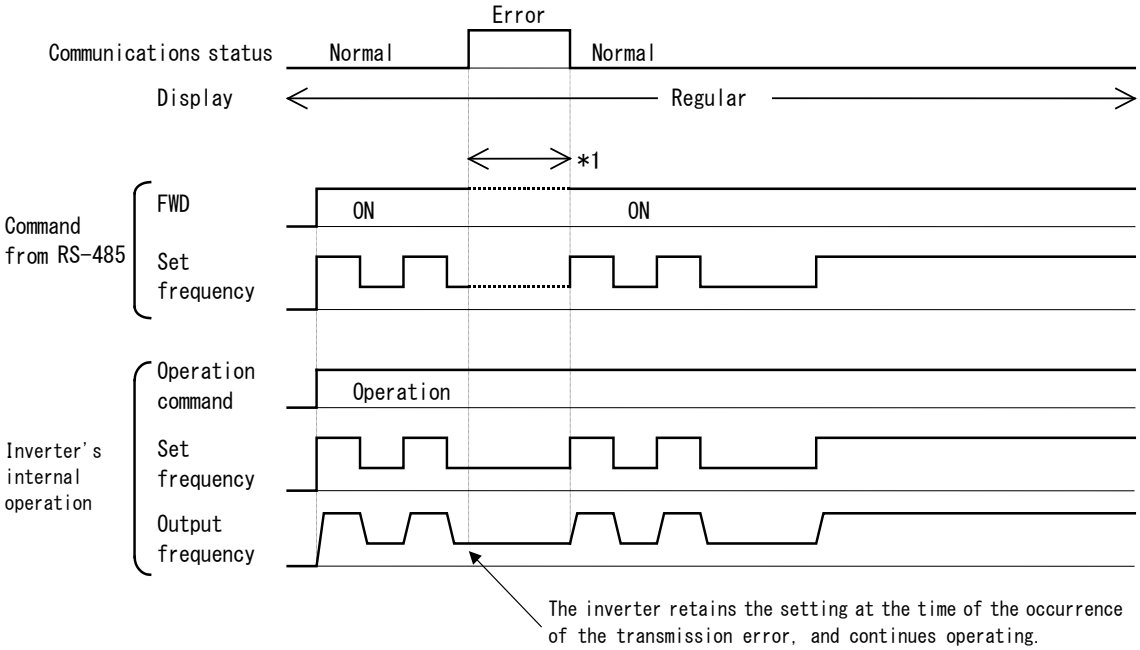
(when a communications error occurred but communications was recovered within five seconds)



*1 For the period until communications is recovered, the command (command data, operation data) executed just before the communications error had occurred is retained.

When y02 = 3

(mode in which the inverter continues operating when a communications error occurs)



*1 For the period until communications is recovered, the command (command data, operation data) executed just before the communications error had occurred is retained.

3.4 CRC-16

3.4.1 Overview of the CRC-16

The CRC (cyclic redundancy check) is a system to confirm whether there is any error in the communications frame during data transmission.
The CRC is among the most effective error check systems. The transmission station calculates and adds CRC data to the last block of the frame, and the receiving station also calculates CRC data against the data received, and compares them with each other.

Steps to calculate CRC data

- Divide data expressed as a polynomial (for example, 0000 0001 0000 0011 0000 0011 0000 0010 0000 0000 0001 0100, the 48-bit data shown in Section 3.4.3 "Calculation example" → $X^{40}+X^{33}+X^{32}+X^{25}+X^{24}+X^{17}+X^{4}+X^{2}$) by a generative polynomial expression (17 bits; $X^{16}+X^{15}+X^{2}+1$). CRC data is the remainder (16 bits) of this division.
- Ignore the quotient, and send a message with the remainder added to the final two characters of the data.
- The receiving station divides this message (with the CRC added) by the generative polynomial expression, and considers the transmitted message to have been received without any error if the "remainder" is 0.

CRC-16

The generative polynomial expression is expressed as a multiplier of X, such as $X^3 + X^2 + 1$, in place of the description of binary code 1101. Although any prime polynomial expression is acceptable as the generative polynomial expression, some standard generative polynomial expressions for optimizing error detection are defined and proposed. The RTU protocol uses the generative polynomial expression ($X^{16} + X^{15} + X^2 + 1$) corresponding to binary code 1 (1000 0000 0000 0101). In this case, the CRC generated is well known as CRC-16.

3.4.2 Algorithm

Figure 3.1 on the following page shows the algorithm for calculating CRC-16. Consult it together with the calculation example that follows.

In this figure, the transmission station calculates CRC data and finally adds it to the transmission frame as a check code.

The receiving station uses the same algorithm to perform a transaction. However, it collates the CRC data it calculated with the transmitted CRC data.

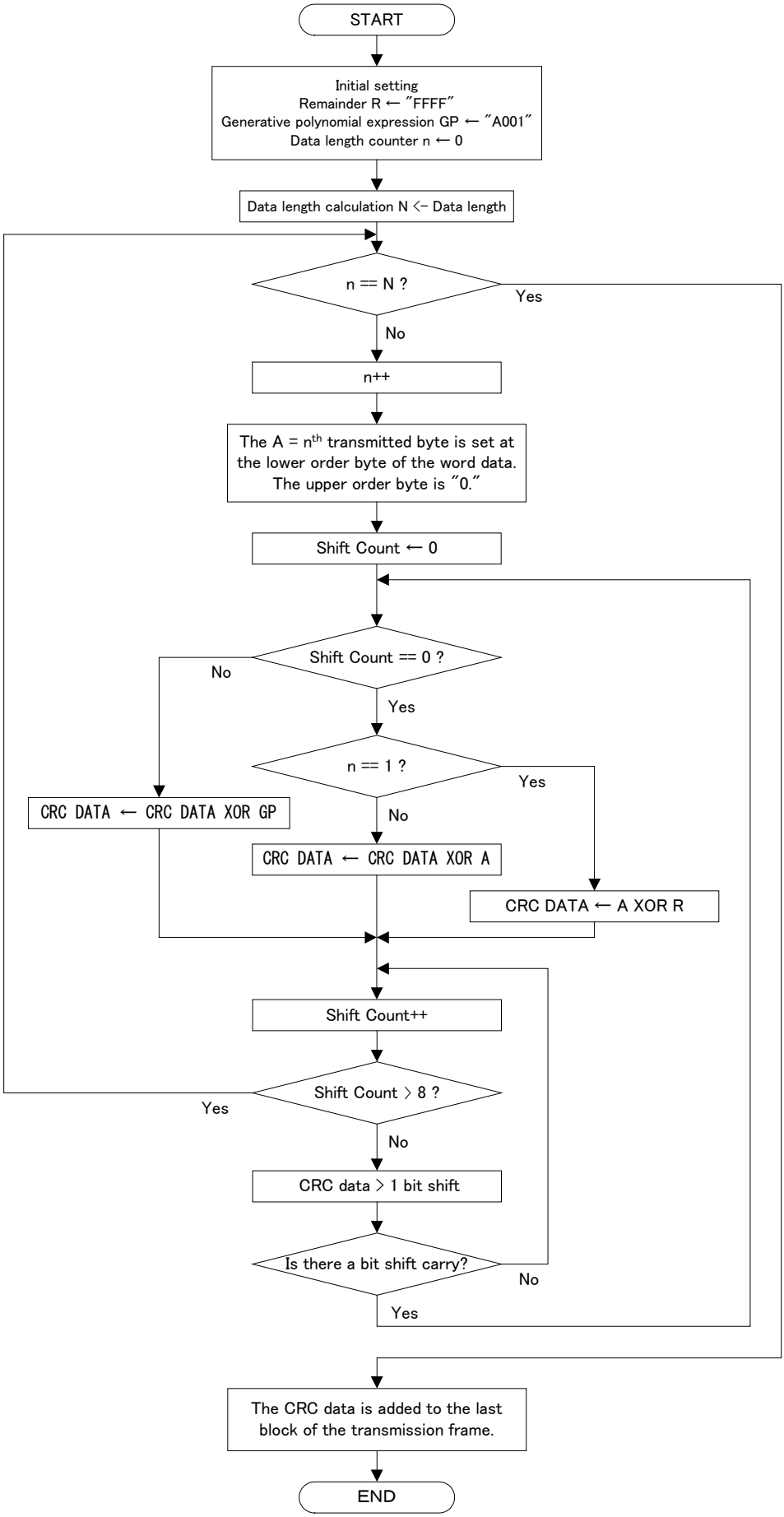

START
Initial setting
Remainder R ← "FFFF"
Generative polynomial expression GP ← "A001"
Data length counter n ← 0
Data length calculation N <- Data length
n == N ?
Yes
No
n++
The A = nth transmitted byte is set at the lower order byte of the word data. The upper order byte is "0."
Shift Count ← 0
Shift Count == 0 ?
No
Yes
n == 1 ?
Yes
No
CRC DATA ← CRC DATA XOR GP
CRC DATA ← CRC DATA XOR A
CRC DATA ← A XOR R
Shift Count++
Shift Count > 8 ?
Yes
No
CRC data > 1 bit shift
Is there a bit shift carry?
No
Yes
The CRC data is added to the last block of the transmission frame.
END

Figure 3.1　CRC algorithm

3.4.3 Calculation example

Example of transmitting read data

Station address = 1, 'FC' = 3, function code = P02 (P = 03_H, 02 = 02_H), number of read data = 20, GP = generative polynomial expression(1010 0000 0000 0001)

Station address	'FC'	Function code		Number of read data	
01_H	03_H	03_H	02_H	00_H	14_H

Table 3.13 CRC data calculation table

N	PROCESS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Flag
1	Initial data R = "FFFF"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
2	1st data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
3	CRC = No.1 Xor No.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	
4	Shift > 2 (up to flag = 1)	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	CRC = No.4 Xor GP	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	
6	Shift > 2	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1
7	CRC = No.6 Xor GP	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	
8	Shift > 2	0	0	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1
9	CRC = No.8 Xor GP	1	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	
10	Shift > 2 (shift of No. 8 terminated)	0	0	1	0	0	0	0	0	0	1	1	1	1	1	1	1	1
11	CRC = No.10 Xor GP	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	
12	2nd data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
13	CRC = No.11 Xor No.12	1	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	
14	Shift > 1	0	1	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1
15	CRC = No.14 Xor GP	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	
16	Shift > 1	0	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1
17	CRC = No.16 Xor GP	1	1	0	1	0	0	0	0	0	0	0	1	1	1	1	0	
18	Shift > 2	0	0	1	1	0	1	0	0	0	0	0	0	0	1	1	1	1
19	CRC = No.18 Xor GP	1	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	
20	Shift > 2	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	1
21	CRC = No.20 Xor GP	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
22	Shift > 2 (shift of No. 8 terminated)	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0
23	3rd data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
24	CRC = No.22 Xor No.23	0	0	1	0	0	0	0	1	0	1	0	0	0	0	1	1	
25	Shift > 1	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	1	1
26	CRC = No.25 Xor GP	1	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	
27	Shift > 6	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1	0	1
28	CRC = No.27 Xor GP	1	0	1	0	0	0	1	0	1	1	0	0	0	0	1	1	
29	Shift > 1	0	1	0	1	0	0	0	1	0	1	1	0	0	0	0	1	1
30	CRC = No.29 Xor GP	1	1	1	1	0	0	0	1	0	1	1	0	0	0	0	0	
31	4th data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
32	CRC = No.30 Xor No.31	1	1	1	1	0	0	0	1	0	1	1	0	0	0	1	0	
33	Shift > 2	0	0	1	1	1	1	0	0	0	1	0	1	1	0	0	0	1
34	CRC = No.33 Xor GP	1	0	0	1	1	1	0	0	0	1	0	1	1	0	0	1	
35	Shift > 1	0	1	0	0	1	1	1	0	0	0	1	0	1	1	0	0	1
36	CRC = No.35 Xor GP	1	1	1	0	1	1	1	0	0	0	1	0	1	1	0	1	
37	Shift > 1	0	1	1	1	0	1	1	1	0	0	0	1	0	1	1	0	1

(To be continued)

Table 3.13 CRC data calculation table (Continued)

N	PROCESS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Flag
38	CRC = No.37 Xor GP	1	1	0	1	0	1	1	1	0	0	0	1	0	1	1	1	
39	Shift > 1	0	1	1	0	1	0	1	1	1	0	0	0	1	0	1	1	1
40	CRC = No.39 Xor GP	1	1	0	0	1	0	1	1	1	0	0	0	1	0	1	0	
41	Shift > 2	0	0	1	1	0	0	1	0	1	1	1	0	0	0	1	0	1
42	CRC = No.41 Xor GP	1	0	0	1	0	0	1	0	1	1	1	0	0	0	1	1	
43	Shift > 1	0	1	0	0	1	0	0	1	0	1	1	1	0	0	0	1	1
44	CRC = No.43 Xor GP	1	1	1	0	1	0	0	1	0	1	1	1	0	0	0	0	
45	5th data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
46	CRC = No.44 Xor No.45	1	1	1	0	1	0	0	1	0	1	1	1	0	0	0	0	
47	Shift > 5	0	0	0	0	0	1	1	1	0	1	0	0	1	0	1	1	1
48	CRC = No.47 Xor GP	1	0	1	0	0	1	1	1	0	1	0	0	1	0	1	0	
49	Shift > 2	0	0	1	0	1	0	0	1	1	1	0	1	0	0	1	0	1
50	CRC = No.49 Xor GP	1	0	0	0	1	0	0	1	1	1	0	1	0	0	1	1	
51	Shift > 1	0	1	0	0	0	1	0	0	1	1	1	0	1	0	0	1	1
52	CRC = No.51 Xor GP	1	1	1	0	0	1	0	0	1	1	1	0	1	0	0	0	
53	6th data byte	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	
54	CRC = No.52 Xor No.53	1	1	1	0	0	1	0	0	1	1	1	1	1	1	0	0	
55	Shift > 3	0	0	0	1	1	1	0	0	1	0	0	1	1	1	1	1	1
56	CRC = No.55 Xor GP	1	0	1	1	1	1	0	0	1	0	0	1	1	1	1	0	
57	Shift > 2	0	0	1	0	1	1	1	1	0	0	1	0	0	1	1	1	1
58	CRC = No.57 Xor GP	1	0	0	0	1	1	1	1	0	0	1	0	0	1	1	0	
59	Shift > 2	0	0	1	0	0	0	1	1	1	1	0	0	1	0	0	1	1
60	CRC = No.59 Xor GP	1	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0	
61	Shift > 1 (shift of No. 8 terminated)	0	1	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0
	Transmitted CRC data	***4***				***1***				***E***				***4***				

From the above calculation, the transmitted data is as shown below:

Station address	'FC'	Function code		Number of read data		CRC check	
01_H	03_H	03_H	02_H	00_H	14_H	$E4_H$	41_H

3.4.4 Frame length calculation

To calculate CRC-16, it is necessary to know the length of variable length messages. The length of all types of messages can be determined according to Table 3.14 Lengths of response messages.

Table 3.14 Length of response messages

'FC'	Description	Query/Broadcast message length (except CRC code)	Length of response message (except CRC code)
1	Read coil status	6 bytes	3 + (3rd) bytes *1
3	Read holding registers	6 bytes	3 + (3rd) bytes *1
5	Force single coil	6 bytes	6 bytes
6	Preset single register	6 bytes	6 bytes
8	Diagnostics	6 bytes	6 bytes
15	Force multiple coils	7 + (7th) bytes *1	6 bytes
16	Preset multiple registers	7 + (7th) bytes *1	6 bytes
128 to 255	Exception function	Unused	3 bytes

*1 7th, 3rd: The 7th and 3 rd byte count values stored in the frame.

CHAPTER 4

FUJI GENERAL-PURPOSE INVERTER PROTOCOL

This chapter describes the Fuji general-purpose inverter protocol, a common protocol to Fuji general-purpose inverters, as well as the host side procedure to use this protocol and error processing.

Table of Contents

4.1 Messages 4-1
4.1.1 Message formats 4-1
4.1.2 Transmission frames 4-2
4.1.3 Descriptions of fields 4-11
4.1.4 Communications examples 4-13
4.2 Host Side Procedures 4-15
4.2.1 Inverter's response time 4-15
4.2.2 Timeout processing 4-16
4.2.3 Receiving preparation complete time and message timing from the host 4-16
4.3 Communications Errors 4-17
4.3.1 Categories of communications errors 4-17
4.3.2 Communications error processing 4-18

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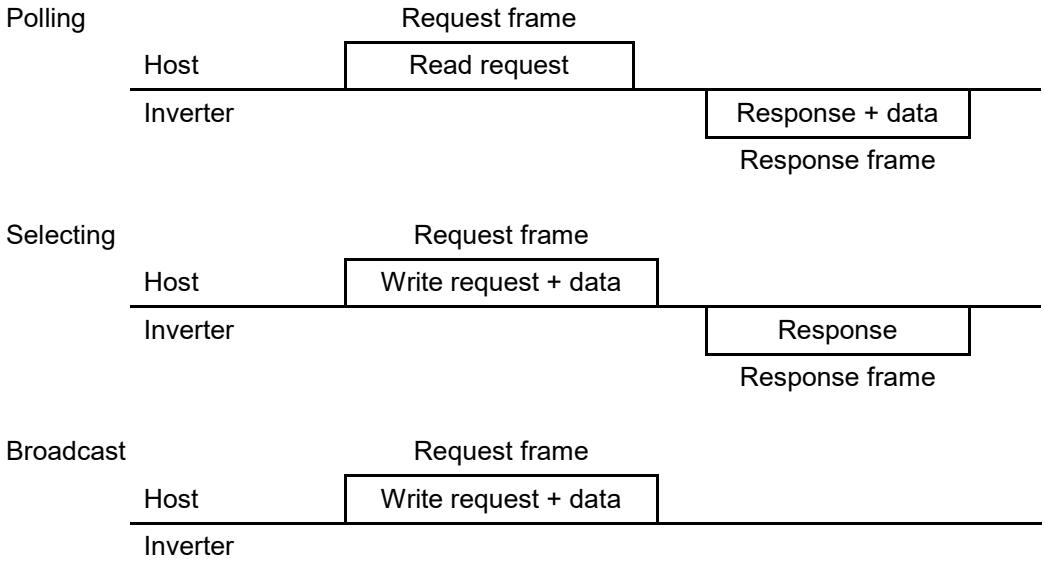
4.1 Messages

4.1.1 Message formats

The polling/selecting system is used to transmit and receive messages. The inverter always waits for selecting (write requests) or polling (read requests) from a host such as a personal computer or PLC.
When the inverter in the standby status receives a request frame from the host addressed to itself (local station) and considers the request frame to have been normally received, the inverter executes the transaction in response to the request, and sends back an acknowledgement (ACK) frame (or response and data in the case of polling). If the inverter judges that the receiving failed, it returns negative acknowledgment (NAK) frame. In the case of broadcast (all station batch selecting), the inverter does not send back response.

(Each frame is described in Section 4.1.2 "Transmission frames.")



Broadcast (all station batch selecting)

A frame with the station address set to 99 is treated by all inverters as broadcast.
By using broadcast, operation or frequency commands can be simultaneously assigned to all inverters.
In broadcast communications, only selecting of S01, S05, S06, S13, S14, S19, S31 to S33, and S90 to S93 in the standard frame, and commands (W, E, a, e, f, and m) in the optional frame are valid.

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4.1.2 Transmission frames

Transmission frames are classified into two types; standard fames with which all communications functions are available, and optional frames, allowing high-speed communications, but whose function is limited to issuing commands to and monitoring the inverter.

All characters (including BCC) comprising both standard and optional frames are represented by ASCII codes. The lengths of standard and optional frames are as shown in Table 4.1 below:

Table 4.1 Lengths of transmission frames

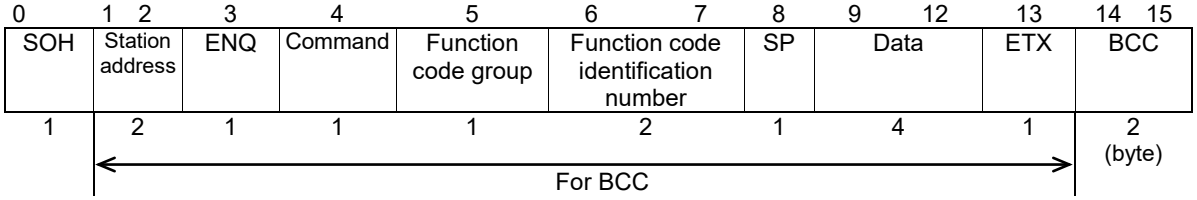
Frame type			Frame length
Standard frame	Selecting	Request	16 bytes
		Response	16 bytes
	Polling	Request	16 bytes
		Response	16 bytes
Optional frame	Selecting	Request	12 bytes
		Response	8 bytes
	Polling	Request	8 bytes
		Response	12 bytes

[1] Standard frame

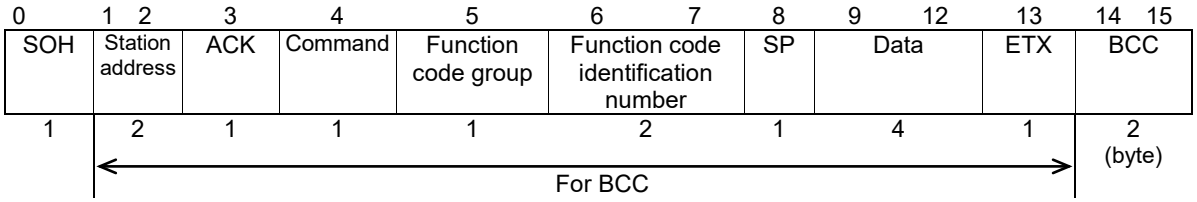
Standard frames are classified into request frame, ACK frame, and NAK frame, and their frame configurations are as shown below.

For the meanings of the fields comprising each frame, see the tables shown on the pages that follow.

Request frame [host ⇒ inverter]



ACK frame [inverter ⇒ host]



NAK frame [inverter ⇒ host]

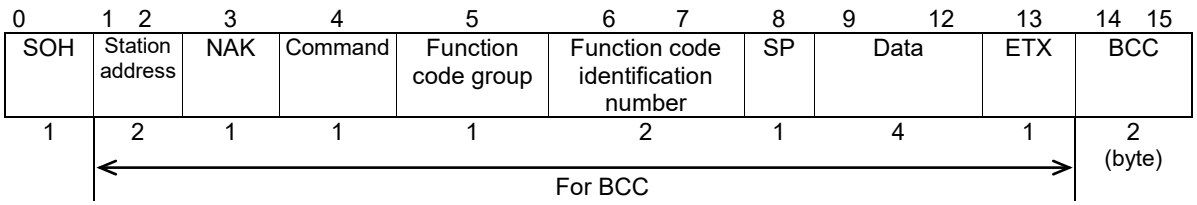


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Table 4.2 Request frame

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3, 9	30_H to 33_H 39_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ENQ	ENQ	05_H	Transmission request
4	Command	R W A E	52_H 57_H 41_H 45_H	Request command Polling (read) Selecting (write) High-speed response selecting (write) *2 Alarm reset
5	Function code group *1			See Table 4.4-1.
6	Function code identification number *1	0 to 9	30_H to 39_H	Function code identification number (decimal: ten's figure)
7		0 to 9	30_H to 39_H	Function code identification number (decimal: one's figure)
8	Special additional data	SP	20_H	Unused (space fixed)
9	Data	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Data's first character (hexadecimal: thousand's figure)
10				Data's second character (hexadecimal: hundred's figure)
11				Data's third character (hexadecimal: ten's figure)
12				Data's fourth character (hexadecimal: one's figure)
13	ETX	ETX	03_H	End of message
14	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
15				Checksum 2 (hexadecimal: one's figure)

*1 A space (SP = 20_H) will be set for an alarm reset command.

*2 Use high-speed response selecting to read the monitor when a command, which takes time for selecting (see Table 4.13 in Section 4.2 "Host Side Procedures"), is written. The inverter does not respond to the regular write command W until writing is completed. With regard to high-speed response command A, the inverter sends back response upon receipt of a write request and communications can, therefore, continue even during writing. To confirm whether writing is completed in this case, read the BUSY flag (M14: 15 bits). If additional writing is performed during writing, NAK (error during writing) will result.

*3 Function codes are divided into function codes that can be edited from the keypad of the inverter, and communications dedicated function codes.

1) Function codes editable from the keypad

Fundamental functions: F code
Extension terminal functions: E code
Control functions: C code
Motor 1 parameters: P code
High performance functions: H code
and others

For the contents of function codes, see Chapter 2, Section 2.4 "Making RS-485-related Settings" and the FRENIC-HVAC/AQUA User's Manual.

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2) Communications dedicated function codes

Command data: S code
Monitor data 1: M code
Monitor data 2: W code
Alarm data 1: X code
Alarm data 2: Z code
and others

For further information about these codes, see Chapter 5 "Function Codes and Data Formats."

Table 4.3 ACK frame

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ACK	ACK	06_H	Transmission response Acknowledgement: There was no receiving or logical error.
4	Command	R W A E	52_H 57_H 41_H 45_H	Answerback of request command Polling (read) Selecting (write) High-speed response selecting (write) Alarm reset
5	Function code group *1			See Table 4.4-1.
6	Function code identification number *1	0 to 9	30_H to 39_H	Function code identification number (decimal: ten's figure)
7		0 to 9	30_H to 39_H	Function code identification number (decimal: one's figure)
8	Special additional data	SP -	20_H $2D_H$	Fixed to "sp (space)" normally. "-" for negative data
9	Data	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Data's first character (hexadecimal: thousand's figure)
10				Data's second character (hexadecimal: hundred's figure)
11				Data's third character (hexadecimal: ten's figure)
12				Data's fourth character (hexadecimal: one's figure)
13	ETX	ETX	03_H	End of message
14	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
15				Checksum 2 (hexadecimal: one's figure)

*1 A space (SP = 20_H) will be set for an alarm reset command.

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Table 4.4 NAK frame

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	NAK	NAK	15_H	Transmission response Negative acknowledgement: There was a logical error in the request.
4	Command *1	 R W A E	 52_H 57_H 41_H 45_H	Answerback of request command Polling (read) Selecting (write) High-speed response selecting (write) Alarm reset
5	Function code group *1			See Table 4.4-1.
6	Function code identification number *1	0 to 9	30_H to 39_H	Function code identification number (decimal: ten's figure)
7		0 to 9	30_H to 39_H	Function code identification number (decimal: one's figure)
8	Special additional data	SP	20_H	Unused (space fixed)
9	Data	SP	20_H	Unused (space fixed)
10		SP	20_H	Unused (space fixed)
11		0 to 9, A to F	30_H to 39_H 41_H to 46_H	Communications error code higher order (hexadecimal: ten's figure)
12				Communications error code lower order (hexadecimal: one's figure)
13	ETX	ETX	03_H	End of message
14	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
15				Checksum 2 (hexadecimal: one's figure)

*1 The field contents of command type, function code group, function code identification number vary at the format error or command error.

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Table 4.4-1 Function code group

Group	Code		Name	Group	Code		Name
F	'F'	46_H	Fundamental functions	M	'M'	$4D_H$	Monitor data
E	'E'	45_H	Extension terminal functions	J	'J'	$4A_H$	Application functions 1
C	'C'	43_H	Control functions	d	'D'	44_H	Application functions 2
P	'P'	50_H	Motor 1 parameters	U	'U'	55_H	Application functions 3
H	'H'	48_H	High performance functions	y	'Y'	59_H	Link functions
S	'S'	53_H	Command/Function data	W	'W'	57_H	Monitor 2
o	'O'	$4F_H$	Operational functions	X	'X'	58_H	Alarm 1
W1	-	$A0_H$	Monitor 3	Z	'Z'	$5A_H$	Alarm 2
W2	-	$A1_H$	Monitor 4	J1	-	$A6_H$	Application functions
W3	-	$A2_H$	Monitor 5	J2	-	$A7_H$	Application functions
X1	-	$A3_H$	Alarm 3	J3	-	$A8_H$	Reserved.
				J4	-	$A9_H$	Application functions
K	'K'	$4B_H$	Keypad functions	J5	-	AA_H	Application functions
T	'T'	54_H	Timer functions	J6	-	AB_H	Application functions
H1	-	81_H	High performance functions 1				
U1	-	89_H	Customizable logic functions				

For function code groups to which no ASCII characters are assigned, use binary codes for setting the function code groups.

To use codes 80H or higher, it is necessary to select 8 bits for the data length using function code y05 or y15 (data = 0).

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[2] Optional frame

This section describes the structure and meaning of each optional frame.

Selecting request frame [host ⇒ inverter]

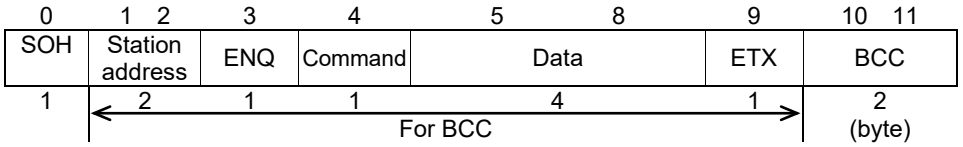

Table 4.5 Selecting request frame

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3, 9	30_H to 33_H 39_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ENQ	ENQ	05_H	Transmission request
4	Command	 a e f m	 61_H 65_H 66_H $6D_H$	Request command Speed setting (S01) Frequency command (S05) Operation command (S06) Reset command (The data part is all zero)
5	Data	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Data's first character (hexadecimal: thousand's figure)
6				Data's second character (hexadecimal: hundred's figure)
7				Data's third character (hexadecimal: ten's figure)
8				Data's fourth character (hexadecimal: one's figure)
9	ETX	ETX	03_H	End of message
10	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
11				Checksum 2 (hexadecimal: one's figure)

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Selecting response frame [inverter ⇒ host]

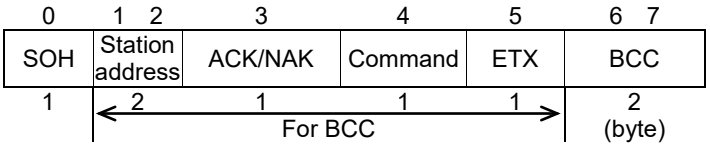

Table 4.6 Selecting response frame (ACK/NAK)

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ACK/NAK	ACK NAK	06_H 15_H	Transmission response Acknowledgement: There was no receiving or logical error. Negative acknowledgment: There was a logical error in the request.
4	Command	a e f m	61_H 65_H 66_H $6D_H$	Request command Speed setting (S01) Frequency command (S05) Operation command (S06) Reset command
5	ETX	ETX	03_H	End of message
6	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
7				Checksum 2 (hexadecimal: one's figure)

Polling request frame [host ⇒ inverter]

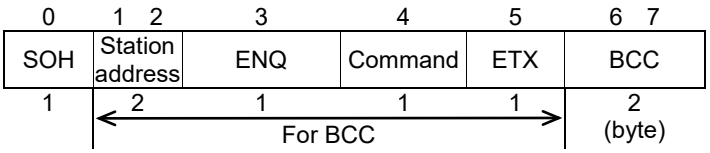

Table 4.7 Polling request frame

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ENQ	ENQ	05_H	Transmission request
4	Command	g j k h	67_H $6A_H$ $6B_H$ 68_H	Request command Actual frequency, actual speed (M06) Output frequency monitor (M09) Operation status monitor (M14) Torque monitor (M07)
5	ETX	ETX	03_H	End of message
6	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
7				Checksum 2 (hexadecimal: one's figure)

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Polling response frame [inverter ⇒ host]

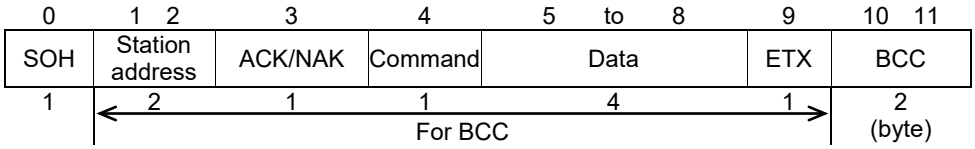

Table 4.8 Polling response frame (ACK)

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ACK/NAK	ACK	06_H	Transmission request Acknowledgement: There was no receiving or logical error.
4	Command	g j k h	67_H $6A_H$ $6B_H$ 68_H	Request command Actual frequency, actual speed (M06) Output frequency monitor (M09) Operation status monitor (M14) Torque monitor (M07)
5	Data	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Data's first character (hexadecimal: thousand's figure)
6				Data's second character (hexadecimal: hundred's figure)
7				Data's third character (hexadecimal: ten's figure)
8				Data's fourth character (hexadecimal: one's figure)
9	ETX	ETX	03_H	End of message
10	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
11				Checksum 2 (hexadecimal: one's figure)

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Table 4.9 Polling response frame (NAK)

Byte	Field	Value		Description
		ASCII format	Hexadecimal format	
0	SOH	SOH	01_H	Start of message
1	Station address	0 to 3	30_H to 33_H	Station address of the inverter (decimal: ten's figure)
2		0 to 9	30_H to 39_H	Station address of the inverter (decimal: one's figure)
3	ACK/NAK	NAK	15_H	Transmission request Negative acknowledgment: There was a logical error in the request.
4	Command	g j k h	67_H $6A_H$ $6B_H$ 68_H	Request command Actual frequency, actual speed (M06) Output frequency monitor (M09) Operation status monitor (M14) Torque monitor (M07)
5	Data	SP	20_H	Unused (fixed space)
		SP	20_H	Unused (fixed space)
		0 to 9, A to F	30_H to 39_H 41_H to 46_H	Communications error code high-order digit (hexadecimal: ten's figure)
				Communications error code low-order digit (hexadecimal: one's figure)
9	ETX	ETX	03_H	End of message
10	BCC	0 to 9, A to F	30_H to 39_H 41_H to 46_H	Checksum 1 (hexadecimal: ten's figure)
11				Checksum 2 (hexadecimal: one's figure)

[3] NAK frame

When the response frame length is determined by the command type and the command type character is correctly identified, response will be given according to the frame length specified by the command in principle. Concerning all the request frames, if the inverter failed to detect ETX after detecting request-to-send character with the specified 3-byte position until reaching the 15-byte position, the inverter returns no response.

Table 4.10 Negative acknowledgment (NAK) frame

No.	Frame/ Command type	Cause of error	NAK response frame	Error code (M26)
1	Standard frame Optional frame	The ENQ was not detected in the specified position.	Standard fame (16 bytes long)	Format error [74]
2	Selecting command (a, e, f, m)	The ETX was not detected in the specified position.	Optional frame (8 bytes long)	Format error [74]
3	Polling command (g, j, k, h, i)	The ETX was not detected in the specified position.	Optional frame (12 bytes long)	Format error [74]
4	Other than specified commands	A command other than the specified commands (R, W, A, E, a, e, f, g, j, k, h, i, m) was detected.	Standard frame (16 bytes long)	Command error [75]

When negative acknowledgement (NAK) for a format or command error is returned with the standard frame as in the case of Nos. 1 and 4, the contents of the command type, function code group, and function code identification number fields will be undefined.

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4.1.3 Descriptions of fields

[1] Command field

The table below shows command types. The applicable frame is different among the command types.

Table 4.11 Command formats

Command	Description	Applicable frame
ASCII R	Reads function code data (polling).	Standard frame
ASCII W	Writes function code data (selecting).	
ASCII A	Writes function code data at high speed (writing that does not wait for writing to be completed).	
ASCII E	Resets an alarm.	
ASCII a	Gives a frequency command (S01). *1	Optional frame
ASCII e	Gives a frequency command (S05). *1	
ASCII f	Gives an operation command (S06). *1	
ASCII g	Reads the output frequency (M06). *1	
ACCII h	Reads the torque monitor (M07). *1	
ASCII j	Reads the output frequency (M09). *1	
ASCII k	Reads the operation status monitor (M14). *1	
ASCII m	Resets an alarm.	

*1 The above commands "a" to "k" are used to read or write data in the function code data format specified in parentheses.

[2] Data field

Standard frame

8	9	10	11	12
Special additional data	Data's first character	Data's second character	Data's third character	Data's fourth character

Optional frame

9	10	11	12
Data's first character	Data's second character	Data's third character	Data's fourth character

All data, except for some special ones, are treated as 16 bits long. In the data field of the communications frame, data is hexadecimal (0000_H – $FFFF_H$), and each digit is represented by an ASCII code. Negative integer data (signed data) is treated as a complement of 2 of the integer data without the sign.

CAUTION
- The alphabetic characters A to F of hexadecimal data must be uppercase.
- Set 0 in all the data fields of the request frame for polling.
- In selecting, the data field of the ACK frame will be undefined.

(Example) When setting 20 Hz with function code S01 (speed setting 1) (maximum frequency = 60 Hz)

1) Calculate the set value according to the data format of S01 (±20000/maximum frequency).
   Data = 20 Hz x ±20000/60 Hz (+ for forward rotation, − for reverse rotation)
   =±6666.6
   ≈±6667

2) Convert the data into hexadecimal (a complement of 2 in the case of negative data).
   Data = 6667 ..... (forward rotation)
   $=1A0B_H$
   Data = −6667 ..... (reverse rotation)
   = 0 − 6667
   Thus,
   65536 − 6667 = 58869 = $E5F5_H$

3) Set the data.

Position	Set value (forward rotation)	Set value (reverse rotation)
Data's first character	ASCII 1	ASCII E
Data's second character	ASCII A	ASCII 5
Data's third character	ASCII 0	ASCII F
Data's fourth character	ASCII B	ASCII 5

[3] Checksum field

The data in this field is intended to check whether there is any error in the communications frame at the time of data transmission. Calculate the data by adding one byte to all fields, except for S0H and the checksum field, treating the last byte of the result as a two-digit hexadecimal value, and converting each digit into an ASCII code.

(Example) When the result of addition is 0123_H

Position	Set value (forward rotation)
Checksum 1	ASCII 2
Checksum 2	ASCII 3

4.1.4 Communications examples

Typical communications examples are shown below (the station address is 12 in all cases):

[1] Standard frame

(Example 1) Selecting S01: speed setting 1 (write)

10 Hz command x 20,000/maximum frequency 50 Hz = 4000d = $0FA0_H$

Request frame (host ⇒ inverter)

SOH	1	2	ENQ	W	S	0	1	SP	0	F	A	0	ETX	7	D

ACK frame (inverter ⇒ host)

SOH	1	2	ACK	W	S	0	1	SP	0	F	A	0	ETX	7	E

NAK frame (inverter ⇒ host) ... Link priority error

SOH	1	2	NAK	W	S	0	1	SP	SP	SP	4	C	ETX	5	D

(Example 2) Polling of M09: output frequency (read)

Request frame (host ⇒ inverter)

SOH	1	2	ENQ	R	M	0	9	SP	0	0	0	0	ETX	5	3

ACK frame (inverter ⇒ host)

SOH	1	2	ACK	R	M	0	9	SP	0	B	B	8	ETX	8	0

[2] Optional frame

(Example 1) Selecting of operation command (write)

Request frame (host ⇒ inverter) ... FWD command

SOH	1	2	ENQ	f	0	0	0	1	ETX	9	2

ACK frame (inverter ⇒ host)

SOH	1	2	ACK	f	ETX	D	2

NAK frame (inverter ⇒ host)

The cause of the error can be confirmed with function code M26 (transmission error transaction code).

SOH	1	2	NAK	f	ETX	E	1

(Example 2) Selecting of operation command in broadcast (write)

Request frame (host ⇒ inverter) ... REV command

SOH	9	9	ENQ	f	0	0	0	2	ETX	A	2

The inverter does not respond to broadcast.

Table 4.12 ASCII code table

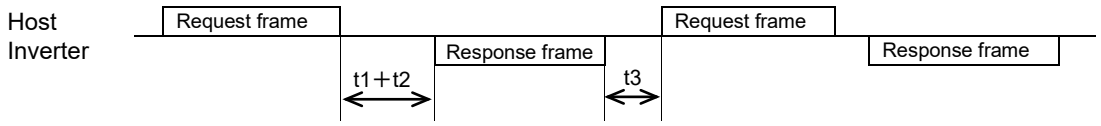
	00_H	10_H	20_H	30_H	40_H	50_H	60_H	70_H
0_H	NUL	DLE	SP	0	@	P	`	p
1_H	SOH	DC1	!	1	A	Q	a	q
2_H	STX	DC2	“	2	B	R	b	r
3_H	ETX	DC3	#	3	C	S	c	s
4_H	EOT	DC4	$	4	D	T	d	t
5_H	ENQ	NAK	%	5	E	U	e	u
6_H	ACK	SYN	&	6	F	V	f	v
7_H	BEL	ETB	‘	7	G	W	g	w
8_H	BS	CAN	(	8	H	X	h	x
9_H	HT	EM	)	9	I	Y	i	y
A_H	LF	SUB	*	:	J	Z	j	z
B_H	VT	ESC	+	;	K	[	k	{
C_H	FF	FS	,	<	L	\	l	|
D_H	CR	GS	–	=	M	]	m	}
E_H	SO	RS	.	>	N	-	n	~
F_H	SI	US	/	?	O	_	o	DEL

The shaded codes are used for this communications protocol.

4.2 Host Side Procedures

4.2.1 Inverter's response time

Upon receipt of a query request from the host, the inverter executes the requested command, and sends back response after the response time shown below:



t1 + t2: Inverter's response time

t1: Response interval time (function code: y09)
The time until the inverter starts to send response to the request from the host can be set. Setting the response interval time enables even the host side with a slow transaction execution speed to adjust timing.

t2: Inverter's transaction time
This is the time until the inverter executes the request and sends back response as shown in Table 4.13 below.

t3: See "4.2.3 Receiving preparation complete time and message timing from the host."

Table 4.13 Inverter's transaction time

Command	Transaction	Description	t2	Timeout time (recommended)
R	Function code read data		≤10 ms	0.1 sec
W	Function code write data	S code commands except S08, S09, S10, S11 and S93	≤10 ms	0.1 sec
		Motor parameter initialization H03 = 2	≤500 ms	1.0 sec
		Data initialization: H03 = 1	≤5 s	10.0 sec
		Function code other than above	≤100 ms	0.5 sec
A	Function code data high-speed writing		≤10 ms	0.1 sec
E, m	Alarm reset		≤10 ms	0.1 sec
a, e, f	Specific function code write data		≤10 ms	0.1 sec
g, h, i, j, k	Specific function code read data		≤10 ms	0.1 sec

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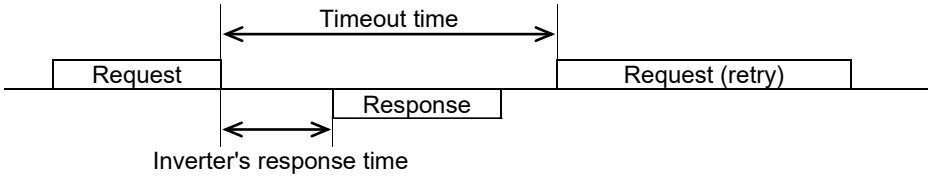
4.2.2 Timeout processing

To read/write data from/to the host, transmit the next frame after confirming response. If response is not transmitted from the inverter for more than a specified period of time (timeout time), it is a timeout, and perform a retry. (If a retry begins before a timeout, the requested frame cannot be received properly.)

The timeout time must be set longer than the response time of the inverter. Table 4.13 above mentioned shows recommended timeout times when no response interval time is set.

In case of a timeout, retransmit the same frame or perform polling (M26) for reading details of an error to confirm whether the inverter sends back normal response. If normal response is returned, this indicates that some transient transmission error occurred due to noise or other reasons, and subsequent communications is normal. (However, if this phenomenon frequently occurs even when normal response is sent back, some problem may exist. Perform a close investigation.) In case of no response, perform another retry. If the number of retries exceeds the set value (generally about three times), there may be a problem with the hardware and the software for the host controller. Investigate and correct the cause.



4.2.3 Receiving preparation complete time and message timing from the host

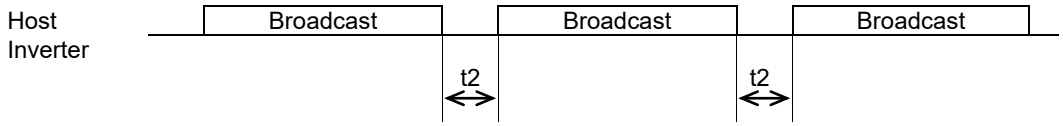
The time from the return of response by the inverter to the completion of receiving preparation of the communications port (switching from transmission to receiving) is called a receiving preparation complete time.

Transmit the following messages after the receiving preparation complete time:

Receiving preparation complete time: 5 ms or less
Message timing from the host (t3): t3 > 5 ms

In the case of broadcast

Upon receipt of a request for a query message from the host by broadcast, the inverter executes the command and enters the receiving enabled status.
Transmit the next message from the host following broadcast after the transaction time (t2) of the inverter.



4.3 Communications Errors

4.3.1 Categories of communications errors

The communications-related errors the inverter detects are listed below:

Table 4.14 Communications errors detected by inverter

Error category	Error name	Description	Error code (M26)	Order of priority
Transmission error	Checksum error	The frame to the local station is found unmatched in checksum collation.	71 (47_H)	–
	Parity error	The parity is unmatched.	72 (48_H)	–
	Other errors	Receiving errors other than the abovementioned (framing error, overrun error)	73 (49_H)	–
Logical error	Format error	- The characters of the transmission request are incorrect. - The last character of the message is not in the specified position.	74 ($4A_H$)	1
	Command error	A command that does not exist was transmitted.	75 ($4B_H$)	2
	Link priority error	A frequency command, PID command, or change command of the run command (writing request to S01, S05, S06, and S13) are sent through the communications route other than that specified with H30.	76 ($4C_H$)	3
	Function code error	A function code that does not exist was requested.	78 ($4E_H$)	4
	Write disabled error	An attempt was made during operation to write the function code for write disabled or for write disabled during operation.	79 ($4F_H$)	5
	Data error	The write data is beyond the writable range.	80 (50_H)	6
	Error during writing	An attempt was made to write another function data during function writing with command A.	81 (51_H)	7
Communications link break error	Communications link break error	The inverter did not receive a normal frame addressed to local station or to other stations within the communications link break detection time specified with the function code.	–	–

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Transmission error (error codes 71 to 73)

When a transmission error occurs eight straight times, it is handled as a communications error. However, the inverter does not return response in order to avoid overlapping of response from multiple inverters. The count of eight straight times will be cleared upon normal receipt of a frame to another station or to the local inverter (station) itself.

Logical error (error codes 74 to 81)

When a logical error is detected, a negative acknowledgment (NAK) frame reports it. For further information, see the NAK response of each frame. Table 4.14 shows the order of priority of logical error. If the alarm is caused by two or more factors, the factor with the highest priority (smallest number) is indicated as an error code.
Concerning all the request frames, if the inverter failed to detect ETX after detecting request-to-send character with the specified 3-byte position until reaching the 15-byte position, the inverter returns no response.

Communications link break error

If the inverter in operation does not receive a normal frame to itself (local station) or to another station when it has received a normal frame more than once and is operating via the communications link (frequency command or run command), this status is regarded as a break.

When a link break status is set and remains over the setting time of function code y08, y18 (communications link break detection time), it is treated as a communications error.

1) Communications link break detection time (y08, y18): 0 (without detection), 1 to 60 (seconds)
2) Condition to clear communications link break detection timer: It will be cleared in a status other than a break.

When it is necessary to take action against errors by factor, the factor can be identified by reading M26. (M26 stores the latest communications error codes.)

4.3.2 Communications error processing

Operations in the case of a transmission or communications link break error are the same as those of the Modbus RTU protocol. See Section 3.3.2 "Operations in case of errors" in Chapter 3 Modbus RTU Protocol.

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CHAPTER 5

FUNCTION CODES AND DATA FORMATS

This chapter describes communication dedicated function codes and the data formats of communications frames.

Table of Contents

5.1 Communications Dedicated Function Codes 5-1
5.1.1 About communications dedicated function codes 5-1
5.1.2 Command data 5-2
5.1.3 Monitor data 1 5-11
5.1.4 Information displayed on the keypad 5-16
5.2 Data Formats 5-32
5.2.1 List of data format numbers 5-32
5.2.2 Data format specifications 5-63

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5.1 Communications Dedicated Function Codes

5.1.1 About communications dedicated function codes

Communications dedicated function codes are available to monitor the operation and status of the inverter via communications. They are classified into the groups shown in Table 5.1 below:

Table 5.1 Types of communications dedicated function codes

Communications dedicated function code group	Function
S	Command data
M	Monitor data 1 (for reading only)
W	Monitor data 2 (for reading only)
W1	Monitor data 3 (for reading only)
W2	Monitor data 4 (for reading only)
W3	Monitor data 5 (for reading only)
X	Alarm information (for reading only)
X1	
Z	

The sections that follow describe communications dedicated function codes of each group.

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5.1.2 Command data

[1] List of command data

The table below shows the function codes (S code) for the command data. The "Support" column indicates whether the function code is supported or not. The symbol "O" means that the code is supported and the symbol "X" means that the code is not supported.

Table 5.2 List of command data

Code	Name	Function	Permissible setting range	In units of	Unit	R/W *	Support	
							HVAC	AQUA
S01	Frequency reference (p.u.)	Frequency command issued through communications (the reference value for maximum frequency)	-32768 to 32767 (Max frequency: at +/- 20000)	1	–	R/W	O	O
S02	Torque command	Torque command issued through communications	-327.68 to 327.67	0.01	%	R/W	×	×
S03	Torque current command	Torque current command issued through communications	-327.68 to 327.67	0.01	%	R/W	×	×
S05	Frequency reference	Frequency command issued through communications (in units of 0.01 Hz)	0.00 to 655.35	0.01	Hz	R/W	O	O
S06	Operation command	Operation command issued through communications [general input terminal functions (X1 to X7, XF (FWD), R (REV)) and FWD, REV, RST only through communications]	0000_H to $FFFF_H$	1	–	R/W	O	O
S07	Universal DO	Command issued to DO terminal through communications	0000_H to $FFFF_H$	1	–	R/W	O	O
S08	Acceleration time F07	Each data is set with the code or communications format common to all the inverter types.	0.0 to 3600.0	0.1	s	R/W	O	O
S09	Deceleration time F08		0.0 to 3600.0	0.1	s	R/W	O	O
S10	Torque limit level (Driving)		20.00 to 150.00, 999	0.01	%	R/W	O	O
S11	Torque limit level (Braking)		20.00 to 150.00, 999	0.01	%	R/W	O	O
S12	Universal AO	Command issued to AO terminal through communications	-32768 to 32767 (Full scale: at +/- 20,000)	1	–	R/W	O	O
S13	PID command	PID command issued through communications	-32768 to 32767 (+/- 20000 corresponds to +/- 100%)	1	–	R/W	O	O
S14	Alarm reset command	Alarm reset command issued through communications	0 or 1	1	–	R/W	O	O
S19	Speed command	Speed command issued via communications	-32768 to 32767	1	min^{-1}	R/W	O	O

* Legends in R/W column...R: Readable, W: Writable, R/W: Readable/writable

Table 5.2 List of command data (Continued)

Code	Name	Function	Permissible setting range	In units of	Unit	R/W *	Support	
							HVAC	AQUA
S31	Ext PID command 1	PID command issued through communications	-32768 to 32767 (+/- 20000 corresponds to +/- 100%)	1	–	R/W	○	○
S32	Ext PID command 2	PID command issued through communications	-32768 to 32767 (+/- 20000 corresponds to +/- 100%)	1	–	R/W	○	○
S33	Ext PID command 3	PID command issued through communications	-32768 to 32767 (+/- 20000 corresponds to +/- 100%)	1	–	R/W	○	○
S90	Current year/month	Clock time setting through communications	2012 to 2099 January to December	1	–	R/W	○	○
S91	Current day/hour	Clock time setting through communications	1st to 31st 0 to 23 o'clock	1	–	R/W	○	○
S92	Current minute/second	Clock time setting through communications	0 to 59 minutes 0 to 59 seconds	1	–	R/W	○	○
S93	Clock setting	Clock time setting through communications	0: Deactivate 1: Write	1	–	R/W	○	○

* Legends in R/W column...R: Readable, W: Writable, R/W: Readable/writable

[2] Frequency, PID command data, and clock setting

Table 5.3 Function codes for frequency, PID command data, and clock setting

Code	Name	Function	Permissible setting range	Min. step	Unit	R/W *
S01	Frequency reference (p.u.)	Frequency command issued through communications (value based on the maximum frequency)	-32768 to 32767 (±20,000 = maximum frequency)	1	–	R/W
S05	Frequency reference	Frequency command issued through communications (by 0.01 Hz)	0.00 to 655.35	0.01	Hz	R/W
S13	PID command	PID command issued through communications	-32768 to 32767 (±100% at ±20,000)	1	–	R/W
S19	Speed command	Speed command issued through communications	-32768 to 32767	1	min^{-1}	R/W
S31	Ext PID command 1	PID command issued through communications	-32768 to 32767 (±100% at ±20,000)	1	–	R/W
S32	Ext PID command 2	PID command issued through communications	-32768 to 32767 (±100% at ±20,000)	1	–	R/W
S33	Ext PID command 3	PID command issued through communications	-32768 to 32767 (±100% at ±20,000)	1	–	R/W
S90	Current year/month	Clock time setting through communications	2012 to 2099 January to December	1	–	R/W
S91	Current day/time	Clock time setting through communications	1st to 31st 0 to 23 o'clock	1	–	R/W
S92	Current minute/second	Clock time setting through communications	0 to 59 minutes 0 to 59 seconds	1	–	R/W
S93	Clock setting	Clock time setting through communications	0: Deactivate 1: Write	1	–	R/W

* Legends in R/W column...R: Readable, W: Writable, R/W: Readable/writable

1) When both S01 and S05 are specified and S01 ≠ 0, the S01 command takes precedence over the S05 command. When both S05 and S19 are specified and S05 ≠ 0, the S05 command takes precedence over the S19 command.
2) The actual operation specified by each command is limited by internal processing of the inverter. For example, a value over 20,000 can be written to S01, but the actual frequency is limited to the maximum frequency or to the upper limit frequency specified with another function code. (Under the PID process control (J01 = 1 or 2), the negative data of S13 is regarded as "0.")
3) When an attempt is made to read the command data shown here, the data previously directed by communications, not the command value for actual operation, will be read. (Obtain the latest command value by reading the M code.)
4) At S01, set a value based on ±20,000 as the maximum frequency. For example, when the maximum frequency is 60 Hz, set 20,000 at S01 with a set frequency of 60 Hz, or 10,000 with a set frequency of 30 Hz.
5) Specifying the clock time data with S90 to S92 and then setting S93 to "1" writes the clock time data into the clock IC built in the inverter. The S93 data will be reset to "0" automatically. For the formats of S90 to S92, refer to the data formats.

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[3] Operation command data

Table 5.4 Function codes for operation command data

Code	Name	Function	Permissible setting range	Min. step	Unit	R/W *
S06	Operation command	Operation command via communications (general-purpose input terminal functions (X1 – X7, XF (FWD), XR (REV)) and communications dedicated command (FWD, REV, RST)	0000_H to $FFFF_H$	1	–	R/W
S14	Alarm reset command	Alarm reset command via communications	0 or 1	1	–	R/W

* Legends in R/W column...R: Readable, W: Writable, R/W: Readable/writable

1) To make alarm resetting with S06, bit 15 must be set to 1 and then set back to 0. Alarm resetting is impossible unless the communications side is made valid by the settings of function codes H30, y98, and y99 and the "LE" assigned terminal.
2) S14 does not require the operation described in 1) above, and writing 1 permits alarm resetting (because writing the value once turns ON the reset command that will be turned OFF after a specific period of time). This command is 0 whenever it is read, and is always valid, irrespective of function codes H30, y98, and y99 and the status of the "LE" assigned terminal.
3) X1 to X7, XF (FWD), and XR (REV) operate according to the functions specified with function codes E01 to E07, E98, and E99.
4) When giving operation command S06 via communications, the relation between S06 and the inverter terminal (external signal input) command is shown in Table 5.5 on the next page. The "Support" column of the table indicates whether each function is supported by the respective models or not. ○ indicates the function is supported, and × indicates the function is not supported.

⚠WARNING

If alarm resetting is performed with the operation command (S06) uncleared, the inverter will start to operate just upon alarm resetting. Before alarm resetting, confirm that the operation command is cleared.

Otherwise, an accident may result.

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Table 5.5 Relation between operation command (S06) and inverter terminal command (external signal input)

Function				When not assigned (positive logic)	Active-ON/OFF *1	Command		Support	
Type	Assign-ment number	Internal operation command symbol	Name			Commu-nications	Terminal block	HVAC	AQUA
Fixed function	–	***FWD***	Run forward/stop	–	ON	Valid	Invalid	○	○
		REV	Run reverse/stop	–	ON			○	○
		RST	Reset alarm	–	ON			○	○
General-purpose input X1 X2 X3 X4 X5 X6 X7 XF (FWD) XR (REV)	0	***SS1***	Select multistep frequency (0 to 1 steps)	OFF	ON	Valid	Invalid	○	○
	1	***SS2***	Select multistep frequency (0 to 3 steps)	OFF	ON			○	○
	2	***SS4***	Select multistep frequency (0 to 7 steps)	OFF	ON			○	○
	3	***SS8***	Select multistep frequency (0 to 15 steps)	OFF	ON			○	○
	4	***RT1***	Select ACC/DEC time (2 steps)	OFF	ON			○	○
	5	***RT2***	Select ACC/DEC time (4 steps)	OFF	ON			○	○
	6	***HLD***	Enable 3-wire operation	OFF	ON	Invalid		○	○
	7	***BX***	Coast to a stop	OFF	ON	Valid		○	○
	8	***RST***	Reset alarm	OFF	ON			○	○
	9	***THR***	Enable external alarm trip	ON	OFF	Invalid	Valid	○	○
	11	***Hz2/Hz1***	Select frequency command 2/1	OFF	ON	Valid	Invalid	○	○
	13	***DCBRK***	Enable DC braking	OFF	ON			○	○
	14	***TL2/TL1***	Select torque limiter level 2/1	OFF	ON			○	○
	15	***SW50***	Switch to commercial power (50 Hz)	OFF	ON			○	○
	16	***SW60***	Switch to commercial power (60 Hz)	OFF	ON			○	○
	17	***UP***	UP command	OFF	ON	Invalid	Valid	○	○
	18	***DOWN***	DOWN command	OFF	ON			○	○
	19	***WE-KP***	Enable data change with keypad	ON	ON	Valid		○	○
	20	***Hz/PID***	Cancel PID control	OFF	ON	Valid	Invalid	○	○
	21	***IVS***	Switch normal/ inverse operation	OFF	ON			○	○
	22	***IL***	Interlock	OFF	ON	Invalid	Valid	○	○
	24	***LE***	Enable communications link	ON	ON			○	○
	25	***U-DI***	Universal DI	OFF	ON			○	○

*1 1: Active ON, 0: Active OFF. Commands entered through the communications link operate in a positive logic regardless of the positive/negative logic signal setting.

Table 5.5 Relation between operation command (S06) and inverter terminal command (external signal input) (Continued)

Function				When not assigned (positive logic)	Active-ON/OFF *1	Command		Support	
Type	Assign-ment number	Internal operation command symbol	Name			Commu-nications	Terminal block	HVAC	AQUA
General-purpose input X1 X2 X3 X4 X5 X6 X7 XF (FWD) XR (REV)	26	***STM***	Enable auto search for idling motor speed	OFF	ON	Valid		○	○
	30	***STOP***	Force to stop	ON	OFF *2			○	○
	33	***PID-RST***	Reset PID integral and differential components	OFF	ON	Valid	Invalid	○	○
	34	***PID-HLD***	Hold PID integral component	OFF	ON			○	○
	35	***LOC***	Select local (keypad) operation	OFF	ON	Invalid	Valid	○	○
	38	***RE***	Enable run commands	ON	ON	Valid	Invalid	○	○
	39	***DWP***	Protect motor from dew condensation	OFF	ON			○	○
	40	***ISW50***	Enable integrated sequence to switch to commercial power (50 Hz)	ON	OFF			○	○
	41	***ISW60***	Enable integrated sequence to switch to commercial power (60 Hz)	ON	OFF			○	○
	50	***MCLR***	Clear running motor regular switching time	OFF	ON			×	○
	58	***STZ***	Reset UP/DOWN frequency	OFF	ON	Valid		○	○
	72	***CRUN-M1***	Count the run time of commercial power-driven motor 1	OFF	ON			○	○
	80	***CLC***	Cancel customizable logic	OFF	ON	Valid	Invalid	○	○
	81	***CLTC***	Clear all customizable logic timers	OFF	ON			○	○
	87	***FR2/FR1***	Run command 2/1	OFF	ON			○	○
	88	***FWD2***	Run forward/stop 2	OFF	ON			○	○
	89	***REV2***	Run reverse/stop 2	OFF	ON			○	○
	98	***FWD*** *2	Run forward/stop	OFF	ON			○	○
	99	***REV*** *2	Run reverse/stop	OFF	ON			○	○
	100	***NONE***	No function assigned	OFF	ON			○	○

*1 1: Active ON, 0: Active OFF. Commands entered through the communications link operate in a positive logic regardless of the positive/negative logic signal setting.

*2 When operation command S06 is given through the communications link, the ***STOP*** command entered from the terminal block and the one given through the communications link are both valid. To enter the ***STOP*** command only from the terminal block, it is necessary to set the corresponding bit of the via-communications command to "1." To enter the ***STOP*** command only through the communications link, it is necessary to assign an Active-OFF signal to the corresponding terminal input.

Table 5.5 Relation between operation command (S06) and inverter terminal command (external signal input) (Continued)

Function				When not assigned (positive logic)	Active-ON/OFF *1	Command		Support	
Type	Assign-ment number	Internal operation command symbol	Name			Commu-nications	Terminal block	HVAC	AQUA
General-purpose input X1 X2 X3 X4 X5 X6 X7 XF (FWD) XR (REV)	130	***BST***	Boost command	OFF	ON	Valid	Invalid	×	○
	131	***FS***	Flowrate switch	OFF	ON			×	○
	132	***FRC***	Filter clogging reverse rotation command	OFF	ON			○	○
	133	***PID2/1***	Switch PID channel	OFF	ON			○	○
	134	***FMS***	Switch to fire mode	OFF	ON	Valid		○	○
	149	***PCHG***	Switch pump control	OFF	ON	Valid	Invalid	×	○
	150	***MEN0***	Enable master motor drive in mutual operation	OFF	ON	Invalid	Valid	×	○
	151	***MEN1***	Enable pump control motor 1 to be driven	OFF	ON			×	○
	152	***MEN2***	Enable pump control motor 2 to be driven	OFF	ON			×	○
	153	***MEN3***	Enable pump control motor 3 to be driven	OFF	ON			×	○
	154	***MEN4***	Enable pump control motor 4 to be driven	OFF	ON			×	○
	155	***MEN5***	Enable pump control motor 5 to be driven	OFF	ON			×	○
	156	***MEN6***	Enable pump control motor 6 to be driven	OFF	ON			×	○
	157	***MEN7***	Enable pump control motor 7 to be driven	OFF	ON			×	○
	158	***MEN8***	Enable pump control motor 8 to be driven	OFF	ON			×	○
	171	***PID-SS1***	PID multistep command 1	OFF	ON	Valid	Invalid	○	○
	172	***PID-SS2***	PID multistep command 2	OFF	ON			○	○
	181	***EPID-SS1***	External PID multistep command 1	OFF	ON			○	○
	182	***EPID-SS2***	External PID multistep command 2	OFF	ON			○	○
	190	***TMC***	Cancel timer	OFF	ON		Valid	○	○
	191	***TM1***	Enable timer 1	ON	ON		Invalid	○	○
	192	***TM2***	Enable timer 2	ON	ON			○	○
	193	***TM3***	Enable timer 3	ON	ON			○	○
	194	***TM4***	Enable timer 4	ON	ON			○	○
	201	***EPID1-ON***	External PID control 1 ON command	OFF	ON			○	○
	202	***%/EPID1***	Cancel external PID control 1	OFF	ON			○	○

*1 1: Active ON, 0: Active OFF. Commands entered through the communications link operate in a positive logic regardless of the positive/negative logic signal setting.

Table 5.5 Relation between operation command (S06) and inverter terminal command (external signal input) (Continued)

Function				When not assigned (positive logic)	Active-ON/OFF *1	Command		Support	
Type	Assign-ment number	Internal operation command symbol	Name			Commu-nications	Terminal block	HVAC	AQUA
General-purpose input X1 X2 X3 X4 X5 X6 X7 XF (FWD) XR (REV)	203	***EPID1-IVS***	Switch normal/inverse operation under external PID control 1	OFF	ON	Valid	Invalid	○	○
	204	***EPID1-RST***	Reset external PID1 integral and differential components	OFF	ON			○	○
	205	***EPID1-HLD***	Hold external PID1 integral component	OFF	ON			○	○
	211	***EPID2-ON***	External PID control 2 ON command	OFF	ON			○	○
	212	***%/EPID2***	Cancel external PID control 2	OFF	ON			○	○
	213	***EPID2-IVS***	Switch normal/ inverse operation under external PID control 2	OFF	ON			○	○
	214	***EPID2-RST***	Reset external PID2 integral and differential components	OFF	ON			○	○
	215	***EPID2-HLD***	Hold external PID2 integral component	OFF	ON			○	○
	221	***EPID3-ON***	External PID control 3 ON command	OFF	ON			○	○
	222	***%/EPID3***	Cancel external PID control 3	OFF	ON			○	○
	223	***EPID3-IVS***	Switch normal/ inverse operation under external PID control 3	OFF	ON			○	○
	224	***EPID3-RST***	Reset external PID3 integral and differential components	OFF	ON			○	○
	225	***EPID3-HLD***	Hold external PID3 integral component	OFF	ON			○	○

*1 1: Active ON, 0: Active OFF. Commands entered through the communications link operate in a positive logic regardless of the positive/negative logic signal setting.

[4] Function data

Table 5.6 Function code and data (S08 to S11)

Code	Name	Function	Permissible setting range	Min. step	Unit	R/W *
S08	Acceleration time F07	Set data with common code numbers and in common communications formats to models.	0.0 to 3600.0	0.1	s	R/W
S09	Deceleration time F08		0.0 to 3600.0	0.1	s	R/W
S10	Torque limit level (Driving)		20.00 to 150.00, 999	0.01	%	R/W
S11	Torque limit level (Braking)		20.00 to 150.00, 999	0.01	%	R/W

* Legends in R/W column...R: Readable, W: Writable, R/W: Readable/writable

1) When an attempt is made to enter a value out of the permissible range, an out-of-range error will result.
2) The acceleration/deceleration times specified with S08 and S09 are set to F07 (Acceleration time 1) and F08 (Deceleration time 1). The torque limit levels specified with S10 and S11 are set to F40 (Torque limit level (Driving)) and F41 (Torque limit level (Braking)). If the function codes are changed through the keypad, etc., the changes are also reflected to S08 to S11.
3) The figures below the fourth place figure of the S08 acceleration time and the S09 deceleration time are omitted within the inverter. (If, for example, 123.4 s is written, 123.0 s is entered.)

[5] Universal DO and universal AO

Table 5.7 Function code and data (S07, S12)

Code	Name	Function	Permissible setting range	Min. step	Unit	R/W *
S07	Universal DO	Command from communications function to terminal DO	0000_H to $FFFF_H$	1	–	R/W
S12	Universal AO	Command from communications function to terminal AO	-32768 to 32767 (Full scale by ±20000)	1	–	R/W

* Legends in R/W column...R: Readable, W: Writable, R/W: Readable/writable

1) A host can control the output terminal of the inverter through the communications function to issue commands to peripheral devices.
2) When universal DO and universal AO are assigned to the following signals, the signals operate as simple output regardless of inverter's operation.
   Universal DO: Transistor output (Y1, Y2, Y3, Y4), relay output (Y5A/C, 30A/B/C)
   Universal AO: Analog output (FMA), pulse output (FMP)

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5.1.3 Monitor data 1

Function codes for monitor data 1 (M codes) are described in the four tables (1 to 4) below. These function codes are for reading only.

The "Support" column of the table indicates whether each function is supported by the respective models or not. ○ indicates the function is supported, and × indicates the function is not supported.

Table 5.8 Monitor data 1 function codes (1)

Code	Name	Description	Monitor range	Min. step	Unit	Support
						HVAC/AQUA
M01	Frequency reference (p.u.) (Final command)	Frequency command based on the maximum frequency	-32768 to 32767 (±20,000 = maximum frequency)	1	–	○
M02	Torque command (Final command)	Torque command based on the motor rated torque (100%)	-327.68 to 327.67	0.01	%	×
M03	Torque current command (Final command)	Torque current command based on the motor rated torque current (100%)	-327.68 to 327.67	0.01	%	×
M04	Flux command	Flux command based on the rated motor flux (100%)	-327.68 to 327.67	0.01	%	×
M05	Frequency reference (Final command)	Frequency command with min. step 0.01 Hz	0.00 to 655.35	0.01	Hz	○
M06	Output frequency 1 (p.u.)	Output frequency based on the maximum frequency (before slip compensation)	-32768 to 32767 (±20,000 = maximum frequency)	1	–	○
M07	Torque real value	Motor output torque based on the motor's rated torque (100%)	-327.68 to 327.67	0.01	%	○
M08	Torque current	Torque current based on the rated torque current of the motor (100%)	-327.68 to 327.67	0.01	%	×
M09	Output frequency	Output frequency with min. step 0.01 Hz	FGI: -655.35 to 655.35 RTU: 0.00 to 655.35	0.01	Hz	○
M10	Input power	Power consumption value based on the "nominal applicable motor output" (100%)	0.00 to 399.99	0.01	%	○
M11	Output current effective value	Output current effective value based on the inverter rated current	0.00 to 399.99 (100% = inverter rated current)	0.01	%	○
M12	Output voltage effective value	Output voltage effective value (min. step: 1.0 V)	0.0 to 1000.0	0.1 *1	V	○

*1 Since M12 does not have any data after the decimal point, the minimum step is 1.0.

Table 5.9 Monitor data 1 function codes (2)

Code	Name	Description	Monitor range	Min. step	Unit	Support
						HVAC/AQUA
M13	Operation command (Final command)	Displays the final command created by information from the keypad, terminal block, and communications, and transmitted to the inverter inside.	0000_H to $FFFF_H$	1	–	○
M14	Operation status	Displays the operation status in bit signal.	0000_H to $FFFF_H$	1	–	○
M15	General-purpose output terminal information	General-purpose output terminal information is monitored.	0000_H to $FFFF_H$	1	–	○
M16	Latest alarm contents	Display alarm contents in the form of code.	0 to 254	1	–	○
M17	Last alarm contents					
M18	Second last alarm contents					
M19	Third last alarm contents					
M20	Cumulative operation time	–	0 to 65535	1	h	○
M21	DC link bus voltage	Displays the DC link bus voltage of the inverter.	0 to 1000	1	V	○
M22	Motor temperature	Motor temperature is displayed.	-30 to 200	1	°C	×
M23	Model code	Displays the series, generation, model, and voltage series in four-digit HEX data.	0000_H to $FFFF_H$	1	–	○
M24	Capacity code	Displays the capacity of the inverter.	0 to 65535	1	–	○
M25	ROM version	Displays the ROM version used in the inverter.	0 to 9999	1	–	○
M26	Transmission error transaction code	Communications error code of RS-485	0 to 127	1	–	○
M27	Frequency reference on alarm (p.u.) (Final command)	Data equivalent to M01 on alarm	-32768 to 32767 (±20,000 = maximum frequency)	1	–	○
M28	Torque command on alarm (Final command)	Data equivalent to M02 on alarm	-327.68 to 327.67	0.01	%	×
M29	Torque current command on alarm (Final command)	Data equivalent to M03 on alarm	-327.68 to 327.67	0.01	%	×
M30	Flux command on alarm (Final command)	Data equivalent to M04 on alarm	-327.68 to 327.67	0.01	%	×

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Table 5.10 Monitor data 1 function codes (3)

Code	Name	Description	Monitor range	Min. step	Unit	Support
						HVAC/AQUA
M31	Frequency reference on alarm (Final command)	Data equivalent to M05 on alarm	0.00 to 655.35	0.01	Hz	○
M32	Output frequency 1 on alarm (p.u.)	Data equivalent to M06 on alarm	-32768 to 32767 (±20,000 = maximum frequency)	1	–	○
M33	Torque real value on alarm	Data equivalent to M07 on alarm	-327.68 to 327.67	0.01	%	○
M34	Torque current on alarm	Data equivalent to M08 on alarm	-327.68 to 327.67	0.01	%	×
M35	Output frequency on alarm	Data equivalent to M09 on alarm	FGI: -655.35 to 655.35 RTU: 0.00 to 655.35	0.01	Hz	○
M36	Input power on alarm	Data equivalent to M10 on alarm	0.00 to 399.99	0.01	%	○
M37	Output current effective value on alarm	Data equivalent to M11 on alarm	0.00 to 399.99 (100% = inverter rated current)	0.01	%	○
M38	Output voltage effective value on alarm	Data equivalent to M12 on alarm	0.0 to 1000.0	1.0	V	○
M39	Operation command on alarm	Data equivalent to M13 on alarm	0000_H to $FFFF_H$	–	–	○
M40	Operation status on alarm	Data equivalent to M14 on alarm	0000_H to $FFFF_H$	–	–	○
M41	Output terminal information on alarm	Data equivalent to M15 on alarm	0000_H to $FFFF_H$	–	–	○
M42	Cumulative operation time on alarm	Data equivalent to M20 on alarm	0 to 65535	1	h	○
M43	DC link bus voltage on alarm	Data equivalent to M21 on alarm	0 to 1000	1	V	○
M44	Inverter internal air temperature on alarm	Air temperature inside the inverter on alarm	0 to 255	1	°C	○
M45	Heat sink temperature on alarm	Data equivalent to M62 on alarm	0 to 255	1	°C	○
M46	Life of main circuit capacitor	The capacity of the main circuit capacitor is 100% when delivered from the factory	0.0 to 100.0	0.1	%	○
M47	Life of PC board electrolytic capacitor	Cumulative operation time of the capacitor packaged on the PC board	0 to 65535	1	10 h	○
M48	Life of heat sink	Cumulative operation time of the heat sink	0 to 65535	1	10 h	○

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Table 5.11 Monitor data 1 function codes (4)

Code	Name	Description	Monitor range	Min. step	Unit	Support
						HVAC/AQUA
M49	Input terminal voltage [12] (p.u.)	Input voltage of terminal [12] (-20,000/-10V, 20,000/10V)	-32768 to 32767	1	–	O
M50	Input terminal current [C1] (p.u.)	Input current of terminal [C1] (0/0 mA, 20,000/20 mA)	0 to 32767	1	–	O
M52	Input terminal voltage [32]	Input voltage of terminal [32] (-20,000/-10V, 20,000/10V)	-32768 to 32767	1	–	O
M53	Input terminal current [C2]	Input current of terminal [C2] (0/0 mA, 20,000/20 mA)	0 to 32767	1	–	O
M54	Input terminal voltage [V2] (p.u.)	Input voltage of terminal [V2] (-20000/10V to 20000/10V)	-32768 to 32767	1	–	O
M61	Inverter internal air temperature	Current temperature inside the inverter	0 to 255	1	°C	O
M62	Heat sink temperature	Current temperature of the heat sink within the inverter	0 to 255	1	°C	O
M63	Load factor	Load rate based on the motor rating	-327.68 to 327.67	0.01	%	O
M64	Motor output	Motor output based on the motor's rated output (kW)	-327.68 to 327.67	0.01	%	O
M65	Motor output on alarm	Motor output on alarm	0 to 32767 (20000 = motor rated output)	1	–	O
M66	Speed detection	Detected speed	-32768 to 32767 (±20,000 = maximum frequency)	1	–	O
M67	Transmission error processing code	Error processing code for data transfer	0 to 127	–	–	O
M68	PID final command	±20000/±100%	–32768 to 32767	1	–	O
M69	Inverter rated current	FGI	0.00 to 9999	Variable	A	O
		RTU (inverter capacity 22 kW (30 HP) or less)	0.00 to 655.35	0.01	A	O
		RTU (inverter capacity 30 kW (40 HP) or more)	0.0 to 6553.5	0.1	A	O

Table 5.13 Monitor data 1 function codes (5)

Code	Name	Description	Monitor range	Min. step	Unit	Support
						HVAC/AQUA
M70	Operation status 2	Displays the operation status in the form of a bit signal.	0000H to FFFFH	1	–	O
M71	Input terminal information	Operation command information from the terminal block and communications	0000H to FFFFH	1	–	O
M72	PID feedback value	PID feedback based on 100% of analog input (±20000/100%)	–32768 to 32767	1	–	O
M73	PID output	PID output based on the maximum frequency (F03) (±20000/100%)	–32768 to 32767	1	–	O
M74	Operating status 2	Displays the operation status in the form of a bit signal.	0000H to FFFFH	1	–	O
M76	Main circuit capacitor life (elapsed time)	Main circuit capacitor use time	0 to 65535 (in units of 10 hours)	1	10 h	O
M77	Main circuit capacitor life (remaining time)	Main circuit capacitor remaining life	0 to 65535 (in units of 10 hours)	1	10 h	O
M78	Rotation speed command	Rotation speed command in units of 1 min^{-1}	-32768 to 32767	1	min^{-1}	O
M79	Rotation speed	Output rotation speed in units of 1 min^{-1}`	-32768 to 32767	1	min^{-1}	O
M81	Remaining time before maintenance (M1)	Time before the next maintenance	0 to 65535 (in units of 10 hours)	1	10 h	O
M85	No. of starting times before maintenance (M1)	Allowable starting times before the next maintenance	0 to 65535	1	Times	O
M86	Light alarm (latest)	Latest light alarm indicated with a code	0 to 254	1	–	O
M87	Light alarm (last)	Last light alarm indicated with a code	0 to 254	1	–	O
M88	Light alarm (second last)	Second last light alarm indicated with a code	0 to 254	1	–	O
M89	Light alarm (third last)	Third last light alarm indicated with a code	0 to 254	1	–	O

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5.1.4 Information displayed on the keypad

The function codes used to read, via RS-485, information displayed on the keypad are classified into W codes, X codes, and Z codes. All of these function codes are for read only.

RTU and FGI in the Remarks field represent the Modbus RTU protocol and the Fuji general-purpose inverter protocol, respectively.

Table 5.12 Keypad-related function code (W codes)

Code	Name	Monitor range	Min step	Unit	Support	Remarks
					HVAC/AQUA	
W01	Operation status	0000H to FFFFH	1	–	○	
W02	Frequency reference	0.00 to 655.35	0.01	Hz	○	
W03	Output frequency (before slip compensation)	0.00 to 655.35	0.01	Hz	○	
W04	Output frequency (after slip compensation)	0.00 to 655.35	0.01	Hz	○	
W05	Output current	0.00 to 9999	Variable	A	○	FGI
		0.00 to 655.35	0.01	A	○	RTU (inverter capacity 22 kW (30 HP) or less)
		0.0 to 6553.5	0.1	A	○	RTU (inverter capacity 30 kW (40 HP) or more)
W06	Output voltage	0.0 to 1000.0	0.1	V	○	
W07	Torque	-999 to 999	1	%	○	
W08	Rotation speed	0.00 to 99990	Variable	min^{-1}	○	
W09	Load rotation speed	0.00 to 99990	Variable	min^{-1}	○	
W10	Line speed	0.00 to 99990	Variable	m/min	×	
W11	PID process command	-999 to 9990	Variable	–	○	PID command value or PID feedback value converted to the physical quantity of the control target by E40 and E41
W12	PID feedback value	-999 to 9990	Variable	–	○	
W13	Level of torque value A	-300 to 300, 999	1	%	○	
W14	Level of torque value B	-300 to 300, 999	1	%	○	
W15	Ratio value	0.00 to 655.35	0.01	%	×	
W16	Rotation speed set value	0.00 to 99990	Variable	min^{-1}	○	
W17	Load speed set value	0.00 to 99990	Variable	min^{-1}	○	
W18	Line speed set value	0.00 to 99990	Variable	min^{-1}	×	
W19	Constant feed time set value	0.00 to 999.9	Variable	min	×	
W20	Constant feed time	0.00 to 999.9	Variable	min	×	
W21	Input power	0.00 to 9999	Variable	kW	○	
W22	Motor output	0.00 to 9999	Variable	kW	○	
W23	Load rate	-999 to 999	1	%	○	
W24	Torque current	-999 to 999	1	%	×	
W26	Flux command value	-999 to 999	1	%	×	
W27	Timer operation remaining time	0 to 9999	1	s	×	

Table 5.12 Keypad-related function code (W codes) (Continued)

Code	Name	Monitor range	Min step	Unit	Support	Remarks
					HVAC/AQUA	
W28	Operation command source	0 to 23	1	–	○	*1
W29	Frequency and PID command source	0 to 39	1	–	○	*2
W30	Speed set value at percentage	0.00 to 100.00	0.01	%	○	
W31	Speed set value at percentage	0.00 to 100.00	0.01	%	○	
W32	PID output	-150.0 to 150.0	0.1	%	○	PID output expressed by a percentage with setting the maximum frequency (F03) to 100%
W33	Analog input monitor	-999 to 9990	Variable	–	○	Inverter's analog input converted by E40 and E41

*1 Operation command source code

Indicates the current source of operation commands.

Code	Description	HVAC/AQUA
0	Run by the keypad (rotation direction: depends on the terminal input)	○
1	Run by the terminals	○
2	Run by the keypad (forward rotation)	○
3	Run by the keypad (reverse rotation)	○
4	Run command 2 (when FR2/FR1 is ON)	○
5	Forced operation (Fire mode)	○
20	Port 1 (RS-485 channel 1) (Note)	○
21	Port 2 (RS-485 channel 2) (Note)	○
22	Bus option	○
23	Loader	×

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*2 Frequency command source/PID command source code

Code	Description	HVAC/AQUA
0	Keypad key operations	○
1	Voltage input (terminal 12)	○
2	Current input (terminal C1)	○
3	Voltage input (terminal 12) + current input (terminal C1)	○
4	Inverter volume	×
5	Voltage input (terminal V2)	○
7	UP/DOWN	○
20	Port 1 (RS-485 channel 1) (Note)	○
21	Port 2 (RS-485 channel 2) (Note)	○
22	Bus option	○
23	Loader	○
24	Multi-step frequency	○
30	PID keypad command	○
31	PID Control 1	○
32	PID Control 2	○
33	PID UP/DOWN command	○
34	PID communications process command	○
36	PID multi-step command	○
39	Forced operation (Fire mode)	○

Codes 0 to 29 indicate frequency command sources when the PID is disabled; Codes 30 or greater indicate PID command sources when the PID is enabled.

(Note) RS-485 port (channel)

	FRENIC-HVAC/AQUA
Port 1 (channel 1)	Keypad connection connector on the inverter unit
Port 2 (channel 2)	Control circuit terminal block on the inverter unit

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Table 5.12 Keypad-related function code (W codes) (Continued)

Code	Name	Monitor range	In units of	Unit	Support	Remarks
					HVAC/AQUA	
W35	Terminal [32] input voltage	-12.0 to 12.0	0.1	V	○	
W36	Terminal [C2] input current	0.0 to 30.0	0.1	mA	○	
W37	Terminal [A0] output voltage	-12.0 to 12.0	0.1	V	○	
W38	Terminal [CS] output current	0.0 to 30.0	0.1	mA	○	
W39	[X7] pulse input monitor	-327.68 to 327.67	0.01	–	×	Unit: kp/s
W40	Control circuit terminal (input)	0000_H to $FFFF_H$	1	–	○	
W41	Control circuit terminal (output)	0000_H to $FFFF_H$	1	–	○	
W42	Communications control signal (input)	0000_H to $FFFF_H$	1	–	○	
W43	Communications control signal (output)	0000_H to $FFFF_H$	1	–	○	
W44	Terminal [12] input voltage	-12.0 to 12.0	0.1	V	○	
W45	Terminal [C1] input current	0.0 to 30.0	0.1	mA	○	
W46	Terminal [FM1] output voltage	0.0 to 12.0	0.1	V	○	
W47	Terminal [FM2] output voltage	0.0 to 12.0	0.1	V	○	
W48	Terminal [FMP] output frequency	0 to 6000	1	p/s	×	The output pulse rate of terminal FMP expressed by (p/s)
W49	Terminal [V2] input voltage	-12.0 to 12.0	0.1	V	○	
W50	Terminal [FM1] output current	0.0 to 30.0	0.1	mA	○	
W51	Situation of input terminals on DIO option	0000_H to $FFFF_H$	1	–	×	
W52	Situation of output terminals on DIO option	0000_H to $FFFF_H$	1	–	×	
W53	Pulse input (Master - side A/B phase)	-327.68 to 327.67	0.01	–	×	Unit: kp/s
W54	Pulse input (Master - side Z phase)	0 to 6000	1	p/s	×	
W55	Pulse input (Slave - side A/B phase)	-327.68 to 327.67	0.01	–	×	Unit: kp/s
W56	Pulse input (Slave - side Z phase)	0 to 6000	1	p/s	×	
W57	Current Position Pulse (Upper column)	-999 to 999	1	–	×	
W58	Current Position Pulse (Lower column)	0 to 9999	1	–	×	

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Table 5.12 Keypad-related function code (W codes) (Continued)

Code	Name	Monitor range	In units of	Unit	Support	Remarks
					HVAC/AQUA	
W59	Stop Position Pulse (Upper column)	-999 to 999	1	–	×	
W60	Stop Position Pulse (Lower column)	0 to 9999	1	–	×	
W61	Difference Pulse of Position(Upper column)	-999 to 999	1	–	×	
W62	Difference Pulse of Position(Lower column)	0 to 9999	1	–	×	
W63	Positioning Status	0 to 10	1	–	×	
W65	Terminal [FM2] output current	0.0 to 30.0	0.1	mA	○	
W66	Synchronous operation error	-999.9 to 999.9	0.1	deg	×	
W67	Cumulative operation time of electrolytic	0 to 9999	1	10h	○	
W68	Cumulative operation time of cooling fan	0 to 9999	1	10h	○	
W69	Circumferential speed	0.00 to 99990	0.01	m/min	×	
W70	Cumulative operation time	0 to 65535	1	h	○	
W71	DC link bus voltage	0 to 1000	1	V	○	
W72	Internal air highest temperature	0 to 255	1	°C	○	
W73	Heat sink maximum temperature	0 to 255	1	°C	○	
W74	Maximum effective current value	0.00 to 9999	Variable	A	○	FGI
		0.00 to 655.35	0.01	A	○	RTU (inverter capacity 22 kW (30 HP) or less
		0.0 to 6553.5	0.0	A	○	RTU (inverter capacity 30 kW (40 HP) or more
W75	Main circuit capacitor's capacity	0.0 to 100.0	0.1	%	○	
W76	Cumulative run time of capacitor on PC board	0 to 65535	1	h	×	
W77	Cumulative run time of cooling fan	0 to 65535	1	h	×	
W78	Number of startups	0 to 65535	1	Times	○	
W79	Cumulative run time of motor	0 to 65535	1	h	×	
W80	Standard fan life	0 to 65535	1	h	×	
W81	Integrating electric power	0.000 to 9999	Variable	–	○	Value calculated by assuming an integral power consumption of 100 kWh as one (100 kWh when W81=1)

Table 5.12 Keypad-related function code (W codes) (Continued)

Code	Name	Monitor range	In units of	Unit	Support	Remarks
					HVAC/AQUA	
W82	Data used integrating electric power	0.000 to 9999	Variable	–	○	Value calculated as integral power consumption (kWh) multiplied by function code E51
W83	Number of RS-485 errors (standard RJ-45 or port 1)	0 to 9999	1	Times	○	
W84	Contents of RS-485 error (standard RJ-45 or port 1)	0 to 127	1	–	○	
W85	Number of RS-485 errors (option or port 2)	0 to 9999	1	Times	○	
W86	Number of option 2 (B-port) communications errors	0 to 9999	1	Times	○	
W87	Inverter's ROM version	0 to 9999	1	–	○	
W89	Remote/multi-function keypad's ROM version	0 to 9999	1	–	○	
W90	Option 1 (A-port) ROM version	0 to 9999	1	–	○	
W91	Option 2 (B-port) ROM version	0 to 9999	1	–	○	
W92	Option 3 (C-port) ROM version	0 to 9999	1	–	○	
W94	Contents of RS-485 error (option or port 2)	0 to 127	1	–	○	
W95	Number of option communications errors	0 to 9999	1	Times	×	
	Option 1 (A-port) No. of communications errors				○	
W96	Content of option communications error	0 to 9999	1	–	×	*
	Option 1 (A-port) Content of communications error				○	
W97	Option 2 (B-port) Content of communications error	0 to 9999	1	–	○	*
W98	Option 3 (C-port) Number of communications errors	0 to 9999	1	Times	○	
W99	Option 3 (C-port) Content of communications error	0 to 9999	1	–	○	*

* Indicates the content of a communications error between the inverter and an option card. For details, see the manual of each option.

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Table 5.12-1 Keypad-related function codes (W1 codes)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	AQUA	
W101	Current year and month	Upper 8 bits: Last 2 digits of the year Lower 8 bits: Month	1	-	○	○	
W102	Current day and hour	Bit 15 0: Ordinary time 1: Daylight saving time Upper 8 bits: Day Lower 8 bits: Hour	1	-	○	○	
W103	Current minute and second	Upper 8 bits: Minute Lower 8 bits: Second	1	-	○	○	
W105	Output current (U phase)	0.00 to 9999	0.01	A	○	○	
W106	Output current (V phase)	0.00 to 9999	0.01	A	○	○	
W107	Output current (W phase)	0.00 to 9999	0.01	A	○	○	
W167	Life expectancy of electrolytic capacitor on PCB	0 to 65535	1	10 h	○	○	
W168	Life expectancy of cooling fan	0 to 65535	1	10 h	○	○	
W170	Cumulative run time	0 to 65535	1	10 h	○	○	
W181	Input watt-hour	0.000 to 9999	0.001	10 MWh	○	○	

Table 5.12-2 Keypad-related function codes (W2 codes)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	AQUA	
W202	PID1 command	-999 to 9990	0.01	-	○	○	
W203	PID1 feedback	-999 to 9990	0.01	-	○	○	
W205	PID2 command	-999 to 9990	0.01	-	○	○	
W206	PID2 feedback	-999 to 9990	0.01	-	○	○	
W212	External PID1 final command (SV)	-999 to 9990	0.01	-	○	○	
W213	External PID1 final feedback (PV)	-999 to 9990	0.01	-	○	○	
W214	External PID1 command (SV)	-999 to 9990	0.01	-	○	○	
W215	External PID1 feedback (PV)	-999 to 9990	0.01	-	○	○	
W216	External PID1 output (MV)	-150.0 to 150.0	0.1	%	○	○	
W217	External PID1 manual command	0.00 to 100.00	0.01	%	○	○	
W218	External PID1 final output	-150.0 to 150.0	0.1	%	○	○	
W224	External PID2 command	-999 to 9990	0.01	-	○	○	
W225	External PID2 feedback	-999 to 9990	0.01	-	○	○	
W226	External PID2 output	-150.0 to 150.0	0.1	-	○	○	
W227	External PID2 manual command	0.00 to 100.00	0.01	%	○	○	
W228	External PID2 final output	-150.0 to 150.0	0.1	%	○	○	
W234	External PID3 command	-999 to 9990	0.01	-	○	○	

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Table 5.12-2 Keypad-related function codes (W2 codes) (Continued)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	AQUA	
W235	External PID3 feedback	-999 to 9990	0.01	-	○	○	
W236	External PID3 output	-150.0 to 150.0	0.1	%	○	○	
W237	External PID3 manual command	0.00 to 100.00	0.01	%	○	○	
W238	External PID3 final output	-150.0 to 150.0	0.1	%	○	○	
W250	Mutual operation - Slave unit 1 Output frequency (before slip compensation)	0.00 to 655.35	0.01	Hz	×	○	
W251	Output current	0.00 to 9999	0.01	A	×	○	
W252	Power consumption	0.00 to 9999	0.01	kW	×	○	
W253	Alarm content (Latest)	Same as M16.	1	-	×	○	
W255	Mutual operation - Slave unit 2 Output frequency (before slip compensation)	0.00 to 655.35	0.01	Hz	×	○	
W256	Output current	0.00 to 9999	0.01	A	×	○	
W257	Power consumption	0.00 to 9999	0.01	kW	×	○	
W258	Alarm content (Latest)	Same as M16.	1	-	×	○	

Table 5.12-3 Keypad-related function codes (W3 codes)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	AQUA	
W301	Input watt-hour monitor interval	0 to 4 0: No data 1: Hourly 2: Daily 3: Weekly 4: Monthly	1	-	○	○	
W302	Input watt-hour monitor start year and month	2012 to 2099 January to December	-	-	○	○	
W303	Input watt-hour monitor start day and time	1st to 31st 0 to 23 o'clock	1	-	○	○	
W304	Input watt-hour monitor 1	0.000 to 9999	0.001	100 kWh	○	○	
W305	Input watt-hour monitor 2	0.000 to 9999	0.001	100 kWh	○	○	
W306	Input watt-hour monitor 3	0.000 to 9999	0.001	100 kWh	○	○	
W307	Input watt-hour monitor 4	0.000 to 9999	0.001	100 kWh	○	○	
W308	Input watt-hour monitor 5	0.000 to 9999	0.001	100 kWh	○	○	
W309	Input watt-hour monitor 6	0.000 to 9999	0.001	100 kWh	○	○	
W310	Input watt-hour monitor 7	0.000 to 9999	0.001	100 kWh	○	○	
W311	Input watt-hour monitor 8	0.000 to 9999	0.001	100 kWh	○	○	
W312	Input watt-hour monitor 9	0.000 to 9999	0.001	100 kWh	○	○	
W313	Input watt-hour monitor 10	0.000 to 9999	0.001	100 kWh	○	○	
W314	Input watt-hour monitor 11	0.000 to 9999	0.001	100 kWh	○	○	
W315	Input watt-hour monitor 12	0.000 to 9999	0.001	100 kWh	○	○	
W316	Input watt-hour monitor 13	0.000 to 9999	0.001	100 kWh	○	○	
W317	Input watt-hour monitor 14	0.000 to 9999	0.001	100 kWh	○	○	
W318	Input watt-hour monitor 15	0.000 to 9999	0.001	100 kWh	○	○	

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Table 5.12-3 Keypad-related function codes (W3 codes) (Continued)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	AQUA	
W319	Input watt-hour monitor 16	0.000 to 9999	0.001	100 kWh	○	○	
W320	Input watt-hour monitor 17	0.000 to 9999	0.001	100 kWh	○	○	
W321	Input watt-hour monitor 18	0.000 to 9999	0.001	100 kWh	○	○	
W322	Input watt-hour monitor 19	0.000 to 9999	0.001	100 kWh	○	○	
W323	Input watt-hour monitor 20	0.000 to 9999	0.001	100 kWh	○	○	
W324	Input watt-hour monitor 21	0.000 to 9999	0.001	100 kWh	○	○	
W325	Input watt-hour monitor 22	0.000 to 9999	0.001	100 kWh	○	○	
W326	Input watt-hour monitor 23	0.000 to 9999	0.001	100 kWh	○	○	
W327	Input watt-hour monitor 24	0.000 to 9999	0.001	100 kWh	○	○	
W328	Input watt-hour monitor 25	0.000 to 9999	0.001	100 kWh	○	○	
W329	Input watt-hour monitor 26	0.000 to 9999	0.001	100 kWh	○	○	
W330	Input watt-hour monitor 27	0.000 to 9999	0.001	100 kWh	○	○	
W331	Input watt-hour monitor 28	0.000 to 9999	0.001	100 kWh	○	○	
W332	Input watt-hour monitor 29	0.000 to 9999	0.001	100 kWh	○	○	
W333	Input watt-hour monitor 30	0.000 to 9999	0.001	100 kWh	○	○	
W334	Input watt-hour monitor 31	0.000 to 9999	0.001	100 kWh	○	○	
W335	Input watt-hour monitor 32	0.000 to 9999	0.001	100 kWh	○	○	
W336	Input watt-hour monitor 33	0.000 to 9999	0.001	100 kWh	○	○	
W337	Input watt-hour monitor 34	0.000 to 9999	0.001	100 kWh	○	○	
W338	Input watt-hour monitor 35	0.000 to 9999	0.001	100 kWh	○	○	
W339	Input watt-hour monitor 36	0.000 to 9999	0.001	100 kWh	○	○	
W340	Input watt-hour monitor 37	0.000 to 9999	0.001	100 kWh	○	○	
W341	Input watt-hour monitor 38	0.000 to 9999	0.001	100 kWh	○	○	
W342	Input watt-hour monitor 39	0.000 to 9999	0.001	100 kWh	○	○	
W343	Input watt-hour monitor 40	0.000 to 9999	0.001	100 kWh	○	○	
W344	Input watt-hour monitor 41	0.000 to 9999	0.001	100 kWh	○	○	
W345	Input watt-hour monitor 42	0.000 to 9999	0.001	100 kWh	○	○	
W346	Input watt-hour monitor 43	0.000 to 9999	0.001	100 kWh	○	○	
W347	Input watt-hour monitor 44	0.000 to 9999	0.001	100 kWh	○	○	
W348	Input watt-hour monitor 45	0.000 to 9999	0.001	100 kWh	○	○	
W349	Input watt-hour monitor 46	0.000 to 9999	0.001	100 kWh	○	○	
W350	Input watt-hour monitor 47	0.000 to 9999	0.001	100 kWh	○	○	
W351	Input watt-hour monitor 48	0.000 to 9999	0.001	100 kWh	○	○	
W352	Run time monitor 1	0.000 to 9999	0.001	h	○	○	
W353	Run time monitor 2	0.000 to 9999	0.001	h	○	○	
W354	Run time monitor 3	0.000 to 9999	0.001	h	○	○	
W355	Run time monitor 4	0.000 to 9999	0.001	h	○	○	
W356	Run time monitor 5	0.000 to 9999	0.001	h	○	○	
W357	Run time monitor 6	0.000 to 9999	0.001	h	○	○	
W358	Run time monitor 7	0.000 to 9999	0.001	h	○	○	
W359	Run time monitor 8	0.000 to 9999	0.001	h	○	○	
W360	Run time monitor 9	0.000 to 9999	0.001	h	○	○	
W361	Run time monitor 10	0.000 to 9999	0.001	h	○	○	
W362	Run time monitor 11	0.000 to 9999	0.001	h	○	○	
W363	Run time monitor 12	0.000 to 9999	0.001	h	○	○	
W364	Run time monitor 13	0.000 to 9999	0.001	h	○	○	

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Table 5.12-3 Keypad-related function codes (W3 codes) (Continued)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	AQUA	
W365	Run time monitor 14	0.000 to 9999	0.001	h	○	○	
W366	Run time monitor 15	0.000 to 9999	0.001	h	○	○	
W367	Run time monitor 16	0.000 to 9999	0.001	h	○	○	
W368	Run time monitor 17	0.000 to 9999	0.001	h	○	○	
W369	Run time monitor 18	0.000 to 9999	0.001	h	○	○	
W370	Run time monitor 19	0.000 to 9999	0.001	h	○	○	
W371	Run time monitor 20	0.000 to 9999	0.001	h	○	○	
W372	Run time monitor 21	0.000 to 9999	0.001	h	○	○	
W373	Run time monitor 22	0.000 to 9999	0.001	h	○	○	
W374	Run time monitor 23	0.000 to 9999	0.001	h	○	○	
W375	Run time monitor 24	0.000 to 9999	0.001	h	○	○	
W376	Run time monitor 25	0.000 to 9999	0.001	h	○	○	
W377	Run time monitor 26	0.000 to 9999	0.001	h	○	○	
W378	Run time monitor 27	0.000 to 9999	0.001	h	○	○	
W379	Run time monitor 28	0.000 to 9999	0.001	h	○	○	
W380	Run time monitor 29	0.000 to 9999	0.001	h	○	○	
W381	Run time monitor 30	0.000 to 9999	0.001	h	○	○	
W382	Run time monitor 31	0.000 to 9999	0.001	h	○	○	
W383	Run time monitor 32	0.000 to 9999	0.001	h	○	○	
W384	Run time monitor 33	0.000 to 9999	0.001	h	○	○	
W385	Run time monitor 34	0.000 to 9999	0.001	h	○	○	
W386	Run time monitor 35	0.000 to 9999	0.001	h	○	○	
W387	Run time monitor 36	0.000 to 9999	0.001	h	○	○	
W388	Run time monitor 37	0.000 to 9999	0.001	h	○	○	
W389	Run time monitor 38	0.000 to 9999	0.001	h	○	○	
W390	Run time monitor 39	0.000 to 9999	0.001	h	○	○	
W391	Run time monitor 40	0.000 to 9999	0.001	h	○	○	
W392	Run time monitor 41	0.000 to 9999	0.001	h	○	○	
W393	Run time monitor 42	0.000 to 9999	0.001	h	○	○	
W394	Run time monitor 43	0.000 to 9999	0.001	h	○	○	
W395	Run time monitor 44	0.000 to 9999	0.001	h	○	○	
W396	Run time monitor 45	0.000 to 9999	0.001	h	○	○	
W397	Run time monitor 46	0.000 to 9999	0.001	h	○	○	
W398	Run time monitor 47	0.000 to 9999	0.001	h	○	○	
W399	Run time monitor 48	0.000 to 9999	0.001	h	○	○	

Note: W301 specifies the monitor interval of input watt-hour and W302 and W303 specify the monitor start time. According to those conditions, the input watt-hour monitor function monitors input watt-hour and run time 48 times. If the monitor exceeds 48 times, this function overwrites the 1st and the following monitor data with the 49th and the following monitor data.

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Table 5.13 Keypad-related function codes (X codes)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	AQUA	
X00	Alarm history (latest)	0000_H to $FFFF_H$	1	–	○	○	
X01	Multiple alarm 1 (latest)	0000_H to $FFFF_H$	1	–	○	○	
X02	Multiple alarm 2 (latest)	0000_H to $FFFF_H$	1	–	○	○	
X03	Sub code (latest)	0 to 9999	1	–	○	○	
X04	Multiple alarm 1 sub code (latest)	0 to 9999	1	–	○	○	
X05	Alarm history (last)	0000_H to $FFFF_H$	1	–	○	○	
X06	Multiple alarm 1 (last)	0000_H to $FFFF_H$	1	–	○	○	
X07	Multiple alarm 2 (last)	0000_H to $FFFF_H$	1	–	○	○	
X08	Sub code (last)	0 to 9999	1	–	○	○	
X09	Multiple alarm 1 sub code (last)	0 to 9999	1	–	○	○	
X10	Alarm history (second last)	0000_H to $FFFF_H$	1	–	○	○	
X11	Multiple alarm 1 (second last)	0000_H to $FFFF_H$	1	–	○	○	
X12	Multiple alarm 2 (second last)	0000_H to $FFFF_H$	1	–	○	○	
X13	Sub code (second last)	0 to 9999	1	–	○	○	
X14	Multiple alarm 1 sub code (second last)	0 to 9999	1	–	○	○	
X15	Alarm history (third last)	0000_H to $FFFF_H$	1	–	○	○	
X16	Multiple alarm 1 (third last)	0000_H to $FFFF_H$	1	–	○	○	
X17	Multiple alarm 2 (third last)	0000_H to $FFFF_H$	1	–	○	○	
X18	Sub code (third last)	0 to 9999	1	–	○	○	
X19	Multiple alarm 1 sub code (third last)	0 to 9999	1	–	○	○	
X20	Latest info. on alarm (output frequency)	0.00 to 655.35	0.01	Hz	○	○	
X21	(output current)	0.00 to 9999	Variable	A	○	○	FGI
		0.00 to 655.35	0.01	A	○	○	RTU (inverter capacity 22 kW (30 HP) or less)
		0.0 to 6553.5	0.1	A	○	○	RTU (inverter capacity 30 kW (40 HP) or more)
X22	(output voltage)	0 to 1000	1	V	○	○	
X23	(torque)	-999 to 999	1	%	○	○	
X24	(reference frequency)	0.00 to 655.35	0.01	Hz	○	○	
X25	(operation status)	0000_H to $FFFF_H$	1	–	○	○	
X26	(cumulative run time)	0 to 65535	1	h	○	○	
X27	(number of startups)	0 to 65535	1	Times	○	○	
X28	(DC link bus voltage)	0 to 1000	1	V	○	○	
X29	(internal air temperature)	0 to 255	1	°C	○	○	
X30	(heat sink temperature)	0 to 255	1	°C	○	○	

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Table 5.13 Keypad-related function codes (X codes) (Continued)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	AQUA	
X31	Latest info. on alarm (control circuit terminal, input)	0000_H to $FFFF_H$	1	–	O	O	
X32	(control circuit terminal, output)	0000_H to $FFFF_H$	1	–	O	O	
X33	(communications control signal, input)	0000_H to $FFFF_H$	1	–	O	O	
X34	(communications control signal, output)	0000_H to $FFFF_H$	1	–	O	O	
X35	(input power)	0.00 to 9999	0.01	kW	O	O	
X36	(running status)	0000_H to $FFFF_H$	1	–	O	O	
X37	(speed detection)	-32768 to 32767	1	–	O	O	
X38	(running situation 3/ running status 2)	0000_H to $FFFF_H$	1	–	O	O	
X54	Light alarm contents (4th last, 1st one)	0 to 65535	1	–	O	O	
X55	(5th last, 1st one)	0 to 65535	1	–	O	O	
X60	Last info. on alarm (output frequency)	0.00 to 655.35	0.01	Hz	O	O	
X61	(output current)	0.00 to 9999	Variable	A	O	O	FGI
		0.00 to 655.35	0.01	A	O	O	RTU (inverter capacity 22 kW (30 HP) or less)
		0.0 to 5000.0	0.1	A	O	O	RTU (inverter capacity 30 kW (40 HP) or more)
X62	(output voltage)	0 to 1000	1	V	O	O	
X63	(torque)	-999 to 999	1	%	O	O	
X64	(reference frequency)	0.00 to 655.35	0.01	Hz	O	O	
X65	(running status)	0000_H to $FFFF_H$	1	–	O	O	
X66	(cumulative run time)	0 to 65535	1	h	O	O	
X67	(number of startups)	0 to 65535	1	Times	O	O	
X68	(DC link bus voltage)	0 to 1000	1	V	O	O	
X69	(internal air temperature)	0 to 255	1	°C	O	O	
X70	(heat sink temperature)	0 to 255	1	°C	O	O	
X71	(control circuit terminal, input)	0000_H to $FFFF_H$	1	–	O	O	
X72	(control circuit terminal, output)	0000_H to $FFFF_H$	1	–	O	O	
X73	(communications control signal, input)	0000_H to $FFFF_H$	1	–	O	O	
X74	(communications control signal, output)	0000_H to $FFFF_H$	1	–	O	O	
X76	(running status)	0000_H to $FFFF_H$	1	–	O	O	
X77	(speed detection)	-32768 to 32767	1	–	O	O	
X78	(running situation 3/ running status 2)	0000_H to $FFFF_H$	1	–	O	O	
X89	Customizable logic (digital input/output)	0000_H to $FFFF_H$	1	–	O	O	
X90	(timer monitor)	0.00 to 600.00	0.01	–	O	O	
X91	(analog input 1)	-999 to 9990	0.01	–	O	O	

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Table 5.13 Keypad-related function codes (X codes) (Continued)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	AQUA	
X92	Customizable logic (analog input 2)	-999 to 9990	0.01	–	○	○	
X93	(analog output)	-999 to 9990	0.01	–	○	○	
X94	Relay output terminal info.	0000_H to $FFFF_H$	1	–	○	○	
X95	Flowrate sensor monitor	-999 to 9990	0.01	–	×	○	The unit depends on the J163 setting.
X96	Terminal (CS2) output current	0.0 to 30.0	0.1	mA	○	○	
X97	Terminal (PTC) input voltage	-12.0 to 12.0	0.1	V	○	○	32767: PTC not selected
X98	Pt option detection temperature (ch1)	-100.0 to 200.0	0.1	°C	○	○	
X99	Pt option detection temperature (ch2)	-100.0 to 200.0	0.1	°C	○	○	

Table 5.13-1 Keypad-related function codes (X1 codes)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	HVAC	
X105	On alarm year/month (latest)	2012 to 2099 January to December	–	–	○	○	
X106	On alarm day/hour (latest)	0 to 65535	–	–	○	○	
X107	On alarm minute/second (latest)	0 to 65535	–	–	○	○	
X115	On alarm year/month (last)	2012 to 2099 January to December	–	–	○	○	
X116	On alarm day/hour (last)	0 to 65535	–	–	○	○	
X117	On alarm minute/second (last)	0 to 65535	–	–	○	○	
X125	On alarm year/month (2nd last)	2012 to 2099 January to December	–	–	○	○	
X126	On alarm day/hour (2nd last)	0 to 65535	–	–	○	○	
X127	On alarm minute/second (2nd last)	0 to 65535	–	–	○	○	
X135	On alarm year/month (3rd last)	2012 to 2099 January to December	–	–	○	○	
X136	On alarm day/hour (3rd last)	0 to 65535	–	–	○	○	
X137	On alarm minute/second (3rd last)	0 to 65535	–	–	○	○	
X140	Alarm history (4th last, 1st one)	Same as M16.	–	–	○	○	
X145	On alarm year/month (4th last)	2012 to 2099 January to December	–	–	○	○	
X146	On alarm day/hour (4th last)	0 to 65535	–	–	○	○	

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Table 5.13-1 Keypad-related function codes (X1 codes) (Continued)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	HVAC	
X147	On alarm minute/second (4th last)	0 to 65535	–	–	○	○	
X150	Alarm history (5th last, 1st one)	Same as M16.	–	–	○	○	
X155	On alarm year/month (5th last)	2012 to 2099 January to December	–	–	○	○	
X156	On alarm day/hour (5th last)	0 to 65535	–	–	○	○	
X157	On alarm minute/second (5th last)	0 to 65535	–	–	○	○	
X160	Alarm history (6th last, 1st one)	Same as M16.	–	–	○	○	
X165	On alarm year/month (6th last)	2012 to 2099 January to December	–	–	○	○	
X166	On alarm day/hour (6th last)	0 to 65535	–	–	○	○	
X167	On alarm minute/second (6th last)	0 to 65535	–	–	○	○	
X170	Alarm history (7th last, 1st one)	Same as M16.	–	–	○	○	
X175	On alarm year/month (7th last)	2012 to 2099 January to December	–	–	○	○	
X176	On alarm day/hour (7th last)	0 to 65535	–	–	○	○	
X177	On alarm minute/second (7th last)	0 to 65535	–	–	○	○	
X180	Alarm history (8th last, 1st one)	Same as M16.	–	–	○	○	
X185	On alarm year/month (8th last)	2012 to 2099 January to December	–	–	○	○	
X186	On alarm day/hour (8th last)	0 to 65535	–	–	○	○	
X187	On alarm minute/second (8th last)	0 to 65535	–	–	○	○	
X190	Alarm history (9th last, 1st one)	Same as M16.	–	–	○	○	
X195	On alarm year/month (9th last)	2012 to 2099 January to December	–	–	○	○	
X196	On alarm day/hour (9th last)	0 to 65535	–	–	○	○	
X197	On alarm minute/second (9th last)	0 to 65535	–	–	○	○	

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Table 5.14 Keypad-related function codes (Z codes)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	HVAC	
Z00	Second last info. on alarm (output frequency)	0.00 to 655.35	0.01	Hz	○	○	
Z01	(output current)	0.00 to 9999	Variable	A	○	○	FGI
		0.00 to 655.35	0.01	A	○	○	RTU (inverter capacity 22 kW (30 HP) or less)
		0.0 to 6553.5	0.1	A	○	○	RTU (inverter capacity 30 kW (40 HP) or more)
Z02	(output voltage)	0 to 1000	1	V	○	○	
Z03	(torque)	-999 to 999	1	%	○	○	
Z04	(reference frequency)	0.00 to 655.35	0.01	Hz	○	○	
Z05	(running status)	0000_H to $FFFF_H$	1	–	○	○	
Z06	(cumulative run time)	0 to 65535	1	h	○	○	
Z07	(number of startups)	0 to 65535	1	Times	○	○	
Z08	(DC link bus voltage)	0 to 1000	1	V	○	○	
Z09	(internal air temperature)	0 to 255	1	°C	○	○	
Z10	(heat sink temperature)	0 to 255	1	°C	○	○	
Z11	(control circuit terminal, input)	0000_H to $FFFF_H$	1	–	○	○	
Z12	(control circuit terminal, output)	0000_H to $FFFF_H$	1	–	○	○	
Z13	(communications control signal, input)	0000_H to $FFFF_H$	1	–	○	○	
Z14	(communications control signal, output)	0000_H to $FFFF_H$	1	–	○	○	
Z16	(running status)	0000_H to $FFFF_H$	1	–	○	○	
Z17	(speed detection)	-32768 to 32767	1	–	○	○	
Z18	(running situation 3/ running status 2)	0000_H to $FFFF_H$	1	–	○	○	
Z40	Cumulative run time of motor (M1)	0 to 65535 (in units of 10 hours)	1	10 h	○	○	
Z48	Retry history (latest)	0 to 127	1	–	○	○	
Z49	(last)	0 to 127	1	–	○	○	
Z50	Third last info. on alarm (output frequency)	0.00 to 655.35	0.01	Hz	○	○	
Z51	(output current)	0.00 to 9999	Variable	A	○	○	FGI
		0.00 to 655.35	0.01	A	○	○	RTU (inverter capacity 22 kW (30 HP) or less)
		0.0 to 5000.0	0.1	A	○	○	RTU (inverter capacity 30 kW (40 HP) or more)
Z52	(output voltage)	0 to 1000	1	V	○	○	
Z53	(torque)	-999 to 999	1	%	○	○	

Table 5.14 Keypad-related function codes (Z codes) (Continued)

Code	Name	Monitor range	In units of	Unit	Support		Remarks
					HVAC	AQUA	
Z54	Third last info. on alarm (reference frequency)	0.00 to 655.35	0.01	Hz	○	○	
Z55	(running status)	0000_H to $FFFF_H$	1	–	○	○	
Z56	(cumulative run time)	0 to 65535	1	h	○	○	
Z57	(number of startups)	0 to 65535	1	Times	○	○	
Z58	(DC link bus voltage)	0 to 1000	1	V	○	○	
Z59	(internal air temperature)	0 to 255	1	°C	○	○	
Z60	(heat sink temperature)	0 to 255	1	°C	○	○	
Z61	(control circuit terminal, input)	0000_H to $FFFF_H$	1	–	○	○	
Z62	(control circuit terminal, output)	0000_H to $FFFF_H$	1	–	○	○	
Z63	(communications control signal, input)	0000_H to $FFFF_H$	1	–	○	○	
Z64	(communications control signal, output)	0000_H to $FFFF_H$	1	–	○	○	
Z66	(running status)	0000_H to $FFFF_H$	1	–	○	○	
Z67	(speed detection)	-32768 to 32767	1	–	○	○	
Z68	(running situation 3, running status 2)	0000_H to $FFFF_H$	1	–	○	○	
Z80	Detected speed	-32768 to 32767	1	min^{-1}	○	○	
Z81	Output torque	-327.68 to 327.67	0.01	%	○	○	
Z82	Load factor	-327.68 to 327.67	0.01	%	○	○	
Z83	Motor output	-327.68 to 327.67	0.01	%	○	○	
Z84	Output current	0.00 to 9999	Variable	A	○	○	FGI
		0.00 to 327.67	0.01	A	○	○	RTU (inverter capacity 22 kW (30 HP) or less)
		0.00 to 3276.7	0.01	A	○	○	RTU (inverter capacity 30 kW (40 HP) or more)
Z85	PID feedback amount	-999 to 9990	Variable	–	○	○	
Z86	Input power	0.00 to 9999	Variable	kW	○	○	
Z87	PID output	-150.0 to 150.0	0.1	%	○	○	

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5.2 Data Formats

5.2.1 List of data format numbers

The following table shows the communications data format numbers for function code data. Create data according to the data format specifications described below. For the data setting range and setting unit, see the FRENIC-HVAC/AQUA User's Manual (Chapter 5.) The "Support" column of the table indicates whether each function is supported by the respective models or not. ○ indicates the function is supported, and × indicates the function is not supported.

RTU and FGI in the Format number field mean the Modbus RTU protocol and the Fuji general-purpose inverter protocol, respectively.

Table 5.15 List of data format numbers (F codes)

Code	Name	Format number	Support	
			HVAC	AQUA
F00	Data Protection	[1]	○	○
F01	Frequency Command 1	[1]	○	○
F02	Operation Method	[1]	○	○
F03	Maximum Frequency 1	[3]	○	○
F04	Base Frequency 1	[3]	○	○
F05	Rated Voltage at Base Frequency 1	[1]	○	○
F06	Maximum Output Voltage 1	[1]	○	○
F07	Acceleration Time 1	[12]	○	○
F08	Deceleration Time 1	[12]	○	○
F09	Torque Boost 1	[3]	○	○
F10	Electronic Thermal Overload Protection for Motor (Select motor characteristics)	[1]	○	○
F11	(Overload detection level)	[24] (FGI)	○	○
		[19] (RTU)	○	○
		[24] (BUS) *1	○	○
F12	(Thermal time constant)	[3]	○	○
F14	Restart Mode after Momentary Power Failure (Mode selection)	[1]	○	○
F15	Frequency Limiter (High)	[3]	○	○
F16	(Low)	[3]	○	○
F18	Bias (Frequency command 1)	[6]	○	○
F20	DC Braking 1 (Braking starting frequency)	[3]	○	○
F21	(Braking level)	[1]	○	○
F22	(Braking time)	[5]	○	○
F23	Starting Frequency 1	[3]	○	○
F24	Starting Frequency 1 (Holding time)	[5]	○	○
F25	Stop Frequency	[3]	○	○
F26	Motor Sound (Carrier frequency)	[1] *2	○	○
F27	(Tone)	[1]	○	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option.

*2 The frequency of 0.75 kHz will be treated as 0.

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Table 5.15 List of data format numbers (F codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
F29	Terminal [FM1] (Mode selection)	[1]	O	O
F30	Terminal [FM1] (Gain to output voltage)	[1]	O	O
F31	Terminal [FM1] (Function)	[1]	O	O
F32	Terminal [FM2] (Mode selection)	[1]	O	O
F34	Terminal [FM2] (Gain to output voltage)	[1]	O	O
F35	Terminal [FM2] (Function)	[1]	O	O
F37	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 1	[1]	O	O
F40	Torque Limiter 1 (Limiting level for driving)	[1]	O	O
F41	Torque Limiter 1 (Limiting level for braking)	[1]	O	O
F42	Drive Control Selection	[1]	O	O
F43	Current Limiter (Mode selection)	[1]	O	O
F44	(Level)	[1]	O	O

Table 5.16 List of data format numbers (E codes)

Code	Name	Format number	Support	
			HVAC	AQUA
E01	Terminal [X1] Function	[1]	O	O
E02	[X2] Function	[1]	O	O
E03	[X3] Function	[1]	O	O
E04	[X4] Function	[1]	O	O
E05	[X5] Function	[1]	O	O
E06	[X6] Function	[1]	O	O
E07	[X7] Function	[1]	O	O
E10	Acceleration Time 2	[12]	O	O
E11	Deceleration Time 2	[12]	O	O
E12	Acceleration Time 3	[12]	O	O
E13	Deceleration Time 3	[12]	O	O
E14	Acceleration Time 4	[12]	O	O
E15	Deceleration Time 4	[12]	O	O
E16	Torque Limiter 2 (Driving)	[1]	O	O
E17	(Braking)	[1]	O	O
E20	Terminal [Y1] Function	[1]	O	O
E21	[Y2] Function	[1]	O	O
E22	[Y3] Function	[1]	O	O
E23	[Y4] Function	[1]	O	O
E24	[Y5A/C] Function	[1]	O	O
E27	[30A/B/C] Function (Relay output)	[1]	O	O
E30	Frequency Arrival (Hysteresis width)	[3]	O	O
E31	Frequency Detection 1 (Level)	[3]	O	O
E32	(Hysteresis width)	[3]	O	O
E34	Overload Early Warning/Current Detection (Level)	[24] (FGI)	O	O
		[19] (RTU)	O	O
		[24] (BUS) *1	O	O
E35	(Timer)	[5]	O	O

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option.

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Table 5.16 List of data format numbers (E codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
E61	Terminal [12] Extended Function	[1]	○	○
E62	Terminal [C1] Extended Function	[1]	○	○
E63	Terminal [V2] Extended Function	[1]	○	○
E64	Saving of Digital Reference Frequency	[1]	○	○
E65	Reference Loss Detection (Continuous running frequency)	[1] *2	○	○
E80	Low Torque Detection (Level)	[1]	○	○
E81	(Timer)	[5]	○	○
E82	Switching Frequency of Accel/Decel Time in Low-Speed Domain	[3]	×	○
E83	Acceleration Time in Low-Speed Domain	[12]	×	○
E84	Deceleration Time in Low-Speed Domain	[12]	×	○
E85	Gradual Deceleration Time Switching Frequency	[3]	×	○
E86	Gradual Deceleration Time (Check valve protection)	[12]	×	○
E98	Terminal [FWD] Function	[1]	○	○
E99	[REV] Function	[1]	○	○

*2 The value of 999 will be treated as $7FFF_H$.

Table 5.17 List of data format numbers (C codes)

Code	Name	Format number	Support	
			HVAC	AQUA
C01	Jump Frequency 1	[3]	○	○
C02	Frequency 2	[3]	○	○
C03	Frequency 3	[3]	○	○
C04	(Hysteresis width)	[3]	○	○
C05	Multistep Frequency 1	[22]	○	○
C06	2	[22]	○	○
C07	3	[22]	○	○
C08	4	[22]	○	○
C09	5	[22]	○	○
C10	6	[22]	○	○
C11	7	[22]	○	○
C12	8	[22]	○	○
C13	9	[22]	○	○
C14	10	[22]	○	○
C15	11	[22]	○	○
C16	12	[22]	○	○
C17	13	[22]	○	○
C18	14	[22]	○	○
C19	15	[22]	○	○

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Table 5.17 List of data format numbers (C codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
C21	Pattern Operation (Mode selection)	[1]	O	O
C22	(Stage 1)	[84]	O	O
C23	(Stage 2)	[84]	O	O
C24	(Stage 3)	[84]	O	O
C25	(Stage 4)	[84]	O	O
C26	(Stage 5)	[84]	O	O
C27	(Stage 6)	[84]	O	O
C28	(Stage 7)	[84]	O	O
C30	Frequency Command 2	[1]	O	O
C31	Analog Input Adjustment for [12] (Offset)	[4]	O	O
C32	(Gain)	[5]	O	O
C33	(Filter time constant)	[5]	O	O
C34	(Gain base point)	[5]	O	O
C35	(Polarity)	[1]	O	O
C36	Analog Input Adjustment for [C1] (Offset)	[4]	O	O
C37	(Gain)	[5]	O	O
C38	(Filter time constant)	[5]	O	O
C39	(Gain base point)	[5]	O	O
C40	Terminal [C1] Input Range Selection	[1]	O	O
C41	Analog Input Adjustment for [V2] (Offset)	[4]	O	O
C42	(Gain)	[5]	O	O
C43	(Filter time constant)	[5]	O	O
C44	(Gain base point)	[5]	O	O
C45	(Polarity)	[1]	O	O
C50	Bias (Frequency command 1) (Bias base point)	[5]	O	O
C53	Selection of Normal/Inverse Operation (Frequency command 1)	[1]	O	O
C55	Analog Input Adjustment for Terminal [12] (Bias value)	[6]	O	O
C56	(Bias base point)	[5]	O	O
C58	(Display unit)	[1]	O	O
C59	(Maximum scale)	[12]	O	O
C60	(Minimum scale)	[12]	O	O
C61	Analog Input Adjustment for Terminal [C1] (Bias value)	[6]	O	O
C62	(Bias base point)	[5]	O	O
C64	(Display unit)	[1]	O	O
C65	(Maximum scale)	[12]	O	O
C66	(Minimum scale)	[12]	O	O
C67	Analog Input Adjustment for Terminal [V2] (Bias value)	[6]	O	O
C68	(Bias base point)	[5]	O	O
C70	(Display unit)	[1]	O	O
C71	(Maximum scale)	[12]	O	O
C72	(Minimum scale)	[12]	O	O

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Table 5.18 List of data format numbers (P codes)

Code	Name	Format number	Support	
			HVAC	AQUA
P01	Motor 1 (No. of poles)	[1]	○	○
P02	(Rated capacity)	[11]	○	○
	When P99 = 1	[25]	○	○
P03	(Rated current)	[24] (FGI)	○	○
		[19] (RTU)	○	○
		[24] (BUS) *1	○	○
P04	(Auto-tuning)	[21]	○	○
P05	(Online tuning)	[1]	○	○
P06	(No-load current)	[24] (FGI)	○	○
		[19] (RTU)	○	○
		[24] (BUS) *1	○	○
P07	(%R1)	[5]	○	○
P08	(%X)	[5]	○	○
P10	(Slip compensation response time)	[5]	○	○
P12	(Rated slip frequency)	[5]	○	○
P99	Motor 1 Selection	[1]	○	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option.

Table 5.19 List of data format numbers (H codes)

Code	Name	Format number	Support	
			HVAC	AQUA
H03	Data Initialization	[1]	○	○
H04	Auto-reset (Times)	[1]	○	○
H05	(Reset interval)	[3]	○	○
H06	Cooling Fan ON/OFF Control	[1]	○	○
H07	Acceleration/Deceleration Pattern	[1]	○	○
H08	Rotational Direction Limitation	[1]	○	○
H09	Starting Mode (Auto search)	[1]	○	○
H11	Deceleration Mode	[1]	○	○
H12	Instantaneous Overcurrent Limiting (Mode selection)	[1]	○	○
H13	Restart Mode after Momentary Power Failure (Restart time)	[3]	○	○
H14	(Frequency fall rate)	[5] *1	○	○
H15	(Continuous running level)	[1]	○	○
H16	(Allowable momentary power failure time)	[3] *1	○	○
H17	Start Mode (Pick up frequency)	[3] *1	×	×
H18	Torque Control (Mode selection)	[1]	×	×
H26	Thermistor (for motor) (Mode selection)	[1]	○	○
H27	(Level)	[5]	○	○
H28	Droop Control	[4]	×	×
H30	Communications Link Function (Mode selection)	[1]	○	○
H42	Capacitance of DC Link Bus Capacitor	[1]	○	○
H43	Cumulative Run Time of Cooling Fan	[74]	○	○

*1 The value of 999 will be treated as 7FFFH.

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Table 5.19 List of data format numbers (H codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
H44	Startup Counter for Motor 1	[1]	○	○
H45	Mock Alarm	[1]	○	○
H46	Starting Mode (Auto search delay time 2)	[3]	○	○
H47	Initial Capacitance of DC Link Bus Capacitor	[1]	○	○
H48	Cumulative Run Time of Capacitors on Printed Circuit Boards	[74]	○	○
H49	Starting Mode (Auto search delay time 1)	[3]	○	○
H50	Non-linear V/f Pattern 1 (Frequency)	[3]	○	○
H51	(Voltage)	[1]	○	○
H52	Non-linear V/f Pattern 2 (Frequency)	[3]	○	○
H53	(Voltage)	[1]	○	○
H56	Deceleration Time for Forced Stop	[12]	○	○
H61	UP/DOWN Control (Initial frequency setting)	[1]	○	○
H63	Low Limiter (Mode selection)	[1]	○	○
H64	(Lower limiting frequency)	[3]	○	○
H68	Slip Compensation 1 (Operating conditions)	[1]	○	○
H69	Automatic Deceleration (Mode selection)	[1]	○	○
H70	Overload Prevention Control	[5] *1	○	○
H71	Deceleration Characteristics	[1]	○	○
H72	Main Power Down Detection (Mode selection)	[1]	○	○
H73	Torque Limiter (Operating conditions)	[1]	×	×
H74	(Control target)	[1]	×	×
H75	(Target quadrants)	[1]	×	×
H76	Torque Limiter (Frequency increment limit for braking)	[3]	○	○
H77	Service Life of DC Link Bus Capacitor (Remaining time)	[74]	○	○
H78	Maintenance Interval (M1)	[74]	○	○
H79	Preset Startup Count for Maintenance (M1)	[1]	○	○
H80	Output Current Fluctuation Damping Gain for Motor 1	[5]	○	○
H89	Electronic Thermal Overload Protection 1 for Motor (Data retention)	[1]	○	○
H90	(Reserved for particular manufacturers)	[1]	○	○
H91	PID Feedback Wire Break Detection	[3]	○	○
H92	Continuity of Running (P)	[7] *1	○	○
H93	(I)	[7] *1	○	○
H94	Cumulative Motor Run Time 1	[74]	○	○
H95	DC Braking (Braking response mode)	[1]	○	○
H96	STOP Key Priority/Start Check Function	[1]	○	○
H97	Clear Alarm Data	[1]	○	○
H98	Protection/Maintenance Function (Mode selection)	[1]	○	○

*1 The value of 999 will be treated as 7FFFH.

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Table 5.19-1 List of data format numbers (H1 codes)

Code	Name	Format number	Support	
			HVAC	AQUA
H104	Number-of-retry Clear Time	[3]	○	○
H105	Retry Target Selection	[1]	○	○
H106	Retry Target Selection 2	[1]	○	○
H110	Input Phase Loss Protection Avoidance Operation (Mode selection)	[1]	○	○
H112	Voltage Shortage Avoidance Operation (Mode selection)	[1]	○	○
H114	Automatic Deceleration (Operation level)	[1]	○	○
H116	Fire Mode (Mode selection)	[1]	○	○
H117	(Confirmation time)	[3]	○	○
H118	(Reference frequency)	[3]	○	○
H119	(Rotation direction)	[1]	○	○
H120	(Start method)	[1]	○	○
H121	(Reset interval)	[3]	○	○
H181	Light Alarm Selection 1	[1]	○	○
H182	Light Alarm Selection 2	[1]	○	○
H183	Light Alarm Selection 3	[1]	○	○
H184	Light Alarm Selection 4	[1]	○	○
H197	User Password 1 (Mode selection)	[1]	○	○

Table 5.20 List of data format numbers (J codes)

Code	Name	Format number	Support	
			HVAC	AQUA
J21	Dew Condensation Prevention (Duty)	[1]	○	○
J22	Commercial Power Switching Sequence	[1]	○	○

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Table 5.20-1 List of data format numbers (J1 codes)

Code	Name		Format number	Support	
				HVAC	AQUA
J101	PID Control 1	(Mode selection)	[1]	○	○
J102		(Command selection)	[1]	○	○
J103		(Feedback selection)	[1]	○	○
J104		(Deviation selection)	[1]	○	○
J105		(Display unit)	[1]	○	○
J106		(Maximum scale)	[12]	○	○
J107		(Minimum scale)	[12]	○	○
J108		(Tuning)	[1]	○	○
J109		(Tuning manipulated value)	[1]	○	○
J110		P (Gain)	[7]	○	○
J111		I (Integral time)	[3]	○	○
J112		D (Differential time)	[5]	○	○
J113		(Feedback filter)	[3]	○	○
J114		(Anti-reset wind-up)	[12]	○	○
J118		(Upper limit of PID process output)	[3]	○	○
J119		(Lower limit of PID process output)	[3]	○	○
J121		(Alarm output selection)	[1]	○	○
J122		(Upper level alarm (AH))	[12]	○	○
J124		(Lower level alarm (AL))	[12]	○	○
J127		(Feedback failure detection (Mode selection))	[1]	○	○
J128		(Feedback failure continuation duration)	[1]	○	○
J129		(Feedback failure upper-limit)	[12]	○	○
J130		(Feedback failure lower-limit)	[12]	○	○
J131		(Feedback failure detection time)	[3]	○	○
J136	PID Multistep Command	(Multistep command 1)	[12]	○	○
J137		(Multistep command 2)	[12]	○	○
J138		(Multistep command 3)	[12]	○	○
J143	Boost Function	(Mode selection)	[1]	×	○
J144		(Operation frequency)	[3]	×	○
J145		(Acceleration time)	[12]	×	○
J146		(Operation time)	[3]	×	○
J147		(Cancel PV level)	[12]	×	○
J149	Slow Flowrate Stop Function	(Mode selection)	[1]	×	○
J150		(Operation level)	[12]	×	○
J151		(Elapsed time)	[1]	×	○
J152		(Auto-operation frequency lower-limit)	[3]	×	○
J153		(Pressurization starting frequency)	[3]	×	○
J154		(Pressurizing time)	[1]	×	○
J156		(Initiation inhibition time)	[1]	×	○
J157		(Cancel frequency)	[3]	×	○
J158		(Cancel deviation level 1)	[12]	×	○
J159		(Cancel delay timer)	[1]	×	○
J160		(Cancel deviation level 2)	[12]	×	○

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Table 5.20-1 List of data format numbers (J1 codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
J163	Flowrate Sensor (Input selection)	[1]	×	○
J164	(ON level)	[12]	×	○
J165	(OFF level)	[12]	×	○
J166	(Input filter)	[5]	×	○
J168	Control of Maximum Starts Per Hour (Input selection)	[1]	×	○
J169	(Number of slow flowrate stop detections)	[1]	×	○
J176	Dry Pump Protection (Input selection)	[1]	×	○
J177	(Detection current)	[24]	×	○
J178	(Deviation)	[12]	×	○
J179	(Flowrate sensor)	[1]	×	○
J180	(Detection timer)	[1]	×	○
J182	End of Curve Protection (Input selection)	[1]	×	○
J183	(Detection current)	[24]	×	○
J184	(Deviation)	[12]	×	○
J185	(Flowrate sensor)	[1]	×	○
J186	(Detection timer)	[1]	×	○
J188	Filter Clogging Prevention/Anti Jam Function (Input selection)	[1]	○	○
J189	Filter Clogging Prevention Function (Reverse operation cycle time)	[1]	○	○
J190	(Load resistance current)	[24]	○	○
J191	(Load resistance PV signal)	[12]	○	○
J192	(Load resistance detection timer)	[1]	○	○
J193	Filter Clogging Prevention/Anti Jam Function (Reverse rotation running frequency)	[3]	○	○
J194	(Reverse rotation running time)	[1]	○	○
J195	(Number of allowable reverse runs)	[1]	○	○
J198	Wet-bulb Temperature Presumption Control	[5]	○	×
J201	PID Control 2 (Mode selection)	[1]	○	○
J202	(Command selection)	[1]	○	○
J203	(Feedback selection)	[1]	○	○
J205	(Display unit)	[1]	○	○
J206	(Maximum scale)	[12]	○	○
J207	(Minimum scale)	[12]	○	○
J208	(Tuning)	[1]	○	○
J209	(Tuning manipulated value)	[1]	○	○
J210	P (Gain)	[7]	○	○
J211	I (Integral time)	[3]	○	○
J212	D (Differential time)	[5]	○	○
J213	(Feedback filter)	[3]	○	○
J214	(Anti-reset wind-up)	[12]	○	○
J218	(Upper limit of PID process output)	[3]	○	○
J219	(Lower limit of PID process output)	[3]	○	○
J221	(Alarm output selection)	[1]	○	○
J222	(Upper level alarm (AH))	[12]	○	○

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Table 5.20-1 List of data format numbers (J1 codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
J223	PID Control 2 (Upper level alarm detection hysteresis width)	[12]	○	○
J224	(Lower level alarm (AL))	[12]	○	○
J225	(Upper level alarm detection hysteresis width)	[12]	○	○
J227	(Feedback failure detection (Mode selection))	[1]	○	○
J228	(Feedback failure continuation duration)	[1]	○	○
J229	(Feedback failure upper-limit)	[12]	○	○
J230	(Feedback failure lower-limit)	[12]	○	○
J231	(Feedback failure detection time)	[3]	○	○
J247	Boost Function (Cancel PV level)	[12]	×	○
J249	Slow Flowrate Stop Function (Mode selection)	[1]	×	○
J250	(Operation level)	[12]	×	○
J251	(Elapsed time)	[1]	×	○
J256	(Initiation inhibition time)	[1]	×	○
J257	(Cancel frequency)	[3]	×	○
J258	(Cancel deviation level 1)	[12]	×	○
J259	(Cancel delay timer)	[1]	×	○
J260	(Cancel deviation level 2)	[12]	×	○
J276	Dry Pump Protection (Input selection)	[1]	×	○
J277	(Detection current)	[24]	×	○
J278	(Deviation)	[12]	×	○
J279	(Flowrate sensor)	[1]	×	○
J280	(Detection timer)	[1]	×	○
J401	Pump Control Mode Selection	[1]	×	○
J402	Communication Master/Slave Selection	[1]	×	○
J403	Number of Slaves	[1]	×	○
J404	Master Input Permeation Selection	[1]	×	○
J411	Motor 1 Mode Selection	[1]	×	○
J412	Motor 2 Mode Selection	[1]	×	○
J413	Motor 3 Mode Selection	[1]	×	○
J414	Motor 4 Mode Selection	[1]	×	○
J415	Motor 5 Mode Selection	[1]	×	○
J416	Motor 6 Mode Selection	[1]	×	○
J417	Motor 7 Mode Selection	[1]	×	○
J418	Motor 8 Mode Selection	[1]	×	○
J425	Motor Switching Procedure	[1]	×	○
J430	Stop of Commercial Power-driven Motors	[1]	×	○
J435	Motor Regular Switching Mode Selection	[1]	×	○
J436	Motor Regular Switching Time	[3]	×	○
J437	Motor Regular Switching Signal Output Time	[5]	×	○
J450	Motor Increase Judgment (Judgment frequency)	[1]	×	○
J451	(Duration time)	[12]	×	○
J452	Motor Decrease Judgment (Judgment frequency)	[1]	×	○
J453	(Duration time)	[12]	×	○
J454	Contactor Restart Time when Switching the Motor	[5]	×	○

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Table 5.20-1 List of data format numbers (J1 codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
J455	Motor Increase Switching Time (Deceleration time)	[12]	×	○
J456	Motor Increase Switching Level	[1]	×	○
J457	Motor Increase PID Control Start Frequency	[1]	×	○
J458	Motor Decrease Switching Time (Acceleration time)	[12]	×	○
J459	Motor Decrease Switching Level	[1]	×	○
J460	Motor Decrease PID Control Start Frequency	[1]	×	○
J461	Motor Increase/Decrease Switching Judgment Non-responsive Area Width	[3]	×	○
J462	Failure Inverter Judgment Time	[3]	×	○
J465	Auxiliary Motor (Frequency operation level)	[3]	×	○
J466	(Hysteresis width)	[3]	×	○
J467	(PV operation level)	[12]	×	○
J468	(Connection timer)	[5]	×	○
J469	(Interrupting timer)	[5]	×	○
J480	Motor Cumulative Run Time (Motor 0)	[1]	×	○
J481	(Motor 1)	[1]	×	○
J482	(Motor 2)	[1]	×	○
J483	(Motor 3)	[1]	×	○
J484	(Motor 4)	[1]	×	○
J485	(Motor 5)	[1]	×	○
J486	(Motor 6)	[1]	×	○
J487	(Motor 7)	[1]	×	○
J488	(Motor 8)	[1]	×	○
J490	Y Terminal ON Maximum Cumulation Count (Y1 Y2)	[45]	×	○
J491	(Y3 Y4)	[45]	×	○
J492	Relay ON Maximum Cumulation Count (Y5A 30AB)	[45]	×	○
J493	(Y6RY to Y12RY)	[45]	×	○
J501	External PID Control 1 (Mode selection)	[1]	○	○
J502	(Remote command selection)	[1]	○	○
J503	(Feedback selection)	[1]	○	○
J504	(Deviation selection)	[1]	○	○
J505	(Display unit)	[1]	○	○
J506	(Maximum scale)	[12]	○	○
J507	(Minimum scale)	[12]	○	○
J510	P (Gain)	[7]	○	○
J511	I (Integral time)	[3]	○	○
J512	D (Differential time)	[5]	○	○
J513	(Feedback filter)	[3]	○	○
J514	(Anti-reset wind-up)	[12]	○	○
J515	(ON/OFF control hysteresis width)	[12]	○	○
J516	(Proportional operation output convergent value)	[1]	○	○
J517	(Proportional cycle)	[1]	○	○

Table 5.20-1 List of data format numbers (J1 codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
J518	External PID Control 1 (Upper limit of PID process output)	[2]	○	○
J519	(Lower limit of PID process output)	[2]	○	○
J520	(Upper and lower limits)	[1]	○	○
J521	(Alarm output selection)	[1]	○	○
J522	(Upper level alarm (AH))	[12]	○	○
J524	(Lower level alarm (AL))	[12]	○	○
J527	(Feedback error detection mode)	[1]	○	○
J529	(Feedback error upper-limit)	[12]	○	○
J530	(Feedback error lower-limit)	[12]	○	○
J531	(Feedback error detection time)	[3]	○	○
J540	(Manual command)	[1]	○	○
J550	External PID Multistep Command (Mode selection)	[1]	○	○
J551	(Multistep command 1)	[12]	○	○
J552	(Multistep command 2)	[12]	○	○
J553	(Multistep command 3)	[12]	○	○
J601	External PID Control 2 (Mode selection)	[1]	○	○
J602	(Remote command selection)	[1]	○	○
J603	(Feedback selection)	[1]	○	○
J605	(Display unit)	[1]	○	○
J606	(Maximum scale)	[12]	○	○
J607	(Minimum scale)	[12]	○	○
J610	P (Gain)	[7]	○	○
J611	I (Integral time)	[3]	○	○
J612	D (Differential time)	[5]	○	○
J613	(Feedback filter)	[3]	○	○
J614	(Anti-reset wind-up)	[12]	○	○
J615	(ON/OFF control hysteresis width)	[12]	○	○
J616	(Proportional operation output convergent value)	[1]	○	○
J617	(Proportion cycle)	[1]	○	○
J618	(Upper limit of PID process output)	[2]	○	○
J619	(Lower limit of PID process output)	[2]	○	○
J620	(Upper and lower limits)	[1]	○	○
J621	(Alarm output selection)	[1]	○	○
J622	(Upper level alarm (AH))	[12]	○	○
J624	(Lower level alarm (AL))	[12]	○	○
J627	(Feedback error detection mode)	[1]	○	○
J629	(Feedback error upper-limit)	[12]	○	○
J630	(Feedback error lower-limit)	[12]	○	○
J631	(Feedback error detection time)	[3]	○	○
J640	(Manual command)	[1]	○	○
J651	External PID Control 3 (Mode selection)	[1]	○	○
J652	(Remote command selection)	[1]	○	○
J653	(Feedback selection)	[1]	○	○
J655	(Display unit)	[1]	○	○

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Table 5.20-1 List of data format numbers (J1 codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
J656	External PID Control 3 (Maximum scale)	[12]	O	O
J657	(Minimum scale)	[12]	O	O
J660	P (Gain)	[7]	O	O
J661	I (Integral time)	[3]	O	O
J662	D (Differential time)	[5]	O	O
J663	(Feedback filter)	[3]	O	O
J664	(Anti-reset wind-up)	[12]	O	O
J665	(ON/OFF control hysteresis width)	[12]	O	O
J666	(Proportional operation output convergent value)	[1]	O	O
J667	(Proportion cycle)	[1]	O	O
J668	(Upper limit of PID process output)	[2]	O	O
J669	(Lower limit of PID process output)	[2]	O	O
J670	(Upper and lower limits)	[1]	O	O
J671	(Alarm output selection)	[1]	O	O
J672	(Upper level alarm (AH))	[12]	O	O
J674	(Lower level alarm (AL))	[12]	O	O
J677	(Feedback error detection mode)	[1]	O	O
J679	(Feedback error upper-limit)	[12]	O	O
J680	(Feedback error lower-limit)	[12]	O	O
J681	(Feedback error detection time)	[3]	O	O
J690	(Manual commands)	[1]	O	O

Table 5.21 List of data format numbers (d codes)

Code	Name	Format number	Support	
			HVAC	AQUA
d51	(Reserved for particular manufacturers)	[1]	O	O
d55	(Reserved for particular manufacturers)	[1]	O	O
d69	(Reserved for particular manufacturers)	[3]	O	O
d98	(Reserved for particular manufacturers)	[1]	O	O
d99	Extension Function 1	[1]	O	O

Table 5.22 List of data format numbers (U codes)

Code	Name	Format number	Support	
			HVAC	AQUA
U00	Customizable Logic (Mode selection)	[1]	O	O
U01	Customizable Logic: Step 1 (Control function)	[1]	O	O
U02	(Input 1)	[1]	O	O
U03	(Input 2)	[1]	O	O
U04	(Function 1)	[12]	O	O
U05	(Function 2)	[12]	O	O
U06	Customizable Logic: Step 2 (Control function)	[1]	O	O
U07	(Input 1)	[1]	O	O
U08	(Input 2)	[1]	O	O
U09	(Function 1)	[12]	O	O
U10	(Function 2)	[12]	O	O

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Table 5.22 List of data format numbers (U codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
U11	Customizable Logic: Step 3 (Control function)	[1]	○	○
U12	(Input 1)	[1]	○	○
U13	(Input 2)	[1]	○	○
U14	(Function 1)	[12]	○	○
U15	(Function 2)	[12]	○	○
U16	Customizable Logic: Step 4 (Control function)	[1]	○	○
U17	(Input 1)	[1]	○	○
U18	(Input 2)	[1]	○	○
U19	(Function 1)	[12]	○	○
U20	(Function 2)	[12]	○	○
U21	Customizable Logic: Step 5 (Control function)	[1]	○	○
U22	(Input 1)	[1]	○	○
U23	(Input 2)	[1]	○	○
U24	(Function 1)	[12]	○	○
U25	(Function 2)	[12]	○	○
U26	Customizable Logic: Step 6 (Control function)	[1]	○	○
U27	(Input 1)	[1]	○	○
U28	(Input 2)	[1]	○	○
U29	(Function 1)	[12]	○	○
U30	(Function 2)	[12]	○	○
U31	Customizable Logic: Step 7 (Control function)	[1]	○	○
U32	(Input 1)	[1]	○	○
U33	(Input 2)	[1]	○	○
U34	(Function 1)	[12]	○	○
U35	(Function 2)	[12]	○	○
U36	Customizable Logic: Step 8 (Control function)	[1]	○	○
U37	(Input 1)	[1]	○	○
U38	(Input 2)	[1]	○	○
U39	(Function 1)	[12]	○	○
U40	(Function 2)	[12]	○	○
U41	Customizable Logic: Step 9 (Control function)	[1]	○	○
U42	(Input 1)	[1]	○	○
U43	(Input 2)	[1]	○	○
U44	(Function 1)	[12]	○	○
U45	(Function 2)	[12]	○	○
U46	Customizable Logic: Step 10 (Control function)	[1]	○	○
U47	(Input 1)	[1]	○	○
U48	(Input 2)	[1]	○	○
U49	(Function 1)	[12]	○	○
U50	(Function 2)	[12]	○	○
U51	Customizable Logic: Step 11 (Control function)	[1]	○	○
U52	(Input 1)	[1]	○	○
U53	(Input 2)	[1]	○	○
U54	(Function 1)	[12]	○	○
U55	(Function 2)	[12]	○	○

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Table 5.22 List of data format numbers (U codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
U56	Customizable Logic: Step 12 (Control function)	[1]	○	○
U57	(Input 1)	[1]	○	○
U58	(Input 2)	[1]	○	○
U59	(Function 1)	[12]	○	○
U60	(Function 2)	[12]	○	○
U61	Customizable Logic: Step 13 (Control function)	[1]	○	○
U62	(Input 1)	[1]	○	○
U63	(Input 2)	[1]	○	○
U64	(Function 1)	[12]	○	○
U65	(Function 2)	[12]	○	○
U66	Customizable Logic: Step 14 (Control function)	[1]	○	○
U67	(Input 1)	[1]	○	○
U68	(Input 2)	[1]	○	○
U69	(Function 1)	[12]	○	○
U70	(Function 2)	[12]	○	○
U71	Customizable Logic Output Signal 1 (Output selection)	[1]	○	○
U72	2	[1]	○	○
U73	3	[1]	○	○
U74	4	[1]	○	○
U75	5	[1]	○	○
U76	6	[1]	○	○
U77	7	[1]	○	○
U81	Customizable Logic Output Signal 1 (Function selection)	[1]	○	○
U82	2	[1]	○	○
U83	3	[1]	○	○
U84	4	[1]	○	○
U85	5	[1]	○	○
U86	6	[1]	○	○
U87	7	[1]	○	○
U91	Customizable Logic Timer Monitor (Step selection)	[1]	○	○
U92	Customizable Logic Calculation Coefficient (Mantissa of calculation coefficient K_{A1})	[8]	○	○
U93	(Exponent of calculation coefficient K_{A1})	[2]	○	○
U94	(Mantissa of calculation coefficient K_{B1})	[8]	○	○
U95	(Exponent of calculation coefficient K_{B1})	[2]	○	○
U96	(Mantissa of calculation coefficient K_{C1})	[8]	○	○
U97	(Exponent of calculation coefficient K_{C1})	[2]	○	○
U101	Customizable Logic Conversion point 1 (X1)	[12]	○	○
U102	(Y1)	[12]	○	○
U103	Conversion point 2 (X2)	[12]	○	○
U104	(Y2)	[12]	○	○
U105	Conversion point 3 (X3)	[12]	○	○
U106	(Y3)	[12]	○	○
U107	Automatic Calculation of Conversion Coefficients (X3)	[1]	○	○

Table 5.23 List of data format numbers (y codes)

Code	Name	Format number	Support	
			HVAC	AQUA
y01	RS-485 Communication 1 (Station address)	[1]	○	○
y02	(Communications error processing)	[1]	○	○
y03	(Timer)	[3]	○	○
y04	(Baud rate)	[1]	○	○
y05	(Data length)	[1]	○	○
y06	(Parity check)	[1]	○	○
y07	(Stop bits)	[1]	○	○
y08	(No response error detection time)	[1]	○	○
y09	(Response interval)	[5]	○	○
y10	(Protocol selection)	[1]	○	○
y11	RS-485 Communication 2 (Station address)	[1]	○	○
y12	(Communications error processing)	[1]	○	○
y13	(Timer)	[3]	○	○
y14	(Baud rate)	[1]	○	○
y15	(Data length)	[1]	○	○
y16	(Parity check)	[1]	○	○
y17	(Stop bits)	[1]	○	○
y18	(No response error detection time)	[1]	○	○
y19	(Response interval)	[5]	○	○
y20	(Protocol selection)	[1]	○	○
y95	Data Clear Processing for Communications Error	[1]	○	○
y97	Communications Data Storage Selection	[1]	×	×
y98	Bus Link Function (Mode selection)	[1]	○	○
y99	Loader Link Function (Mode selection)	[1]	○	○

Table 5.24 List of data format numbers (o codes)

Code	Name	Format number	Support	
			HVAC	AQUA
o01	Terminal [Y6A/B/C] Function (Relay output card)	[1]	○	○
o02	Terminal [Y7A/B/C] Function (Relay output card)	[1]	○	○
o03	Terminal [Y8A/B/C] Function (Relay output card)	[1]	○	○
o04	Terminal [Y9A/B/C] Function (Relay output card)	[1]	○	○
o05	Terminal [Y10A/B/C] Function (Relay output card)	[1]	○	○
o06	Terminal [Y11A/B/C] Function (Relay output card)	[1]	○	○
o07	Terminal [Y12A/B/C] Function (Relay output card)	[1]	○	○
o09	Pt Channel (Display unit)	[1]	○	○
o10	Pt Channel 1 (Sensor type)	[1]	○	○
o11	(Extended functions)	[1]	○	○
o12	(Filter)	[3]	○	○
o15	Pt Channel 2 (Sensor type)	[1]	○	○
o16	(Extended functions)	[1]	○	○
o17	(Filter)	[3]	○	○

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Table 5.24 List of data format numbers (o codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
o19	DI Option (DI polarity selection)	[1]	×	×
o20	(DI function selection)	[1]	×	×
o21	DO Option (DO function selection)	[1]	×	×
o27	Response Error (Operation mode selection)	[1]	○	○
o28	(Timer)	[3]	○	○
o30	Bus Setting Parameter 01	[1]	○	○
o31	02	[1]	○	○
o32	03	[1]	○	○
o33	04	[1]	○	○
o34	05	[1]	○	○
o35	06	[1]	○	○
o36	07	[1]	○	○
o37	08	[1]	○	○
o38	09	[1]	○	○
o39	10	[1]	○	○
o40	Write Code Assignment 1	[1]	○	○
o41	2	[1]	○	○
o42	3	[1]	○	○
o43	4	[1]	○	○
o44	5	[1]	○	○
o45	6	[1]	○	○
o46	7	[1]	○	○
o47	8	[1]	○	○
o48	Read Code Assignment 1	[1]	○	○
o49	2	[1]	○	○
o50	3	[1]	○	○
o51	4	[1]	○	○
o52	5	[1]	○	○
o53	6	[1]	○	○
o54	7	[1]	○	○
o55	8	[1]	○	○
o56	9	[1]	○	○
o57	10	[1]	○	○
o58	11	[1]	○	○
o59	12	[1]	○	○
o60	Terminal [32] Extended Function	[1]	○	○
o61	(Offset)	[4]	○	○
o62	(Gain)	[5]	○	○
o63	(Filter time constant)	[5]	○	○
o64	(Gain base point)	[5]	○	○
o65	(Polarity)	[1]	○	○
o66	(Bias value)	[6]	○	○
o67	(Bias base point)	[5]	○	○
o69	(Display unit)	[1]	○	○
o70	(Maximum scale)	[12]	○	○
o71	(Minimum scale)	[12]	○	○

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Table 5.24 List of data format numbers (o codes) (Continued)

Code	Name		Format number	Support	
				HVAC	AQUA
o75	Terminal [C2]	(Current range)	[1]	○	○
o76		(Function)	[1]	○	○
o77		(Offset)	[4]	○	○
o78		(Gain)	[5]	○	○
o79		(Filter time constant)	[5]	○	○
o81		(Gain reference point)	[5]	○	○
o82		(Bias value)	[6]	○	○
o83		(Bias base point)	[5]	○	○
o85		(Display unit)	[1]	○	○
o86		(Maximum scale)	[12]	○	○
o87		(Minimum scale)	[12]	○	○
o90	Terminal [Ao/CS2] Function	(Function)	[1]	○	○
o91		(Output gain)	[1]	○	○
o93		(Polarity)	[1]	○	○
o96	Terminal [CS/CS1] Function	(Function)	[1]	○	○
o97		(Output gain)	[1]	○	○

Table 5.25 List of data format numbers (T codes)

Code	Name		Format number	Support	
				HVAC	AQUA
T01	Timer 1 Operation	(Operating mode)	[1]	○	○
T02		(Start time)	[88]	○	○
T03		(End time)	[88]	○	○
T04		(Start day of the week)	[94]	○	○
T06	Timer 2 Operation	(Operating mode)	[1]	○	○
T07		(Start time)	[88]	○	○
T08		(End time)	[88]	○	○
T09		(Start day of the week)	[94]	○	○
T11	Timer 3 Operation	(Operating mode)	[1]	○	○
T12		(Start time)	[88]	○	○
T13		(End time)	[88]	○	○
T14		(Start day of the week)	[94]	○	○
T16	Timer 4 Operation	(Operating mode)	[1]	○	○
T17		(Start time)	[88]	○	○
T18		(End time)	[88]	○	○
T19		(Start day of the week)	[94]	○	○
T51	Timer Operation	(Pause date 1)	[89]	○	○
T52		(Pause date 2)	[89]	○	○
T53		(Pause date 3)	[89]	○	○
T54		(Pause date 4)	[89]	○	○
T55		(Pause date 5)	[89]	○	○
T56		(Pause date 6)	[89]	○	○
T57		(Pause date 7)	[89]	○	○
T58		(Pause date 8)	[89]	○	○

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Table 5.25 List of data format numbers (T codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
T59	Timer Operation (Pause date 9)	[89]	○	○
T60	(Pause date 10)	[89]	○	○
T61	(Pause date 11)	[89]	○	○
T62	(Pause date 12)	[89]	○	○
T63	(Pause date 13)	[89]	○	○
T64	(Pause date 14)	[89]	○	○
T65	(Pause date 15)	[89]	○	○
T66	(Pause date 16)	[89]	○	○
T67	(Pause date 17)	[89]	○	○
T68	(Pause date 18)	[89]	○	○
T69	(Pause date 19)	[89]	○	○
T70	(Pause date 20)	[89]	○	○

Table 5.26 List of data format numbers (K codes)

Code	Name	Format number	Support	
			HVAC	AQUA
K01	LCD Monitor (Language selection)	[1]	○	○
K02	(Backlight OFF time)	[1]	○	○
K03	(Backlight brightness control)	[1]	○	○
K04	(Contrast control)	[1]	○	○
K08	LCD Monitor Status Display/Hide Selection	[1]	○	○
K10	Main Monitor (Display item selection)	[1]	○	○
K11	(Speed monitor item)	[1]	○	○
K12	(Display when stopped)	[1]	○	○
K15	Sub Monitor (Display type)	[1]	○	○
K16	Sub Monitor 1 (Display item selection)	[1]	○	○
K17	Sub Monitor 2 (Display item selection)	[1]	○	○
K20	Bar Chart 1 (Display item selection)	[1]	○	○
K21	Bar Chart 2 (Display item selection)	[1]	○	○
K22	Bar Chart 3 (Display item selection)	[3]	○	○
K29	Display Filter	[5]	○	○
K30	Coefficient for Speed Indication	[1]	○	○
K31	Display Unit for Input Watt-hour Data	[1]	○	○
K32	Display Coefficient for Input Watt-hour Data	[45]	○	○
K33	Long-term, Input Watt-hour Data Monitor	[1]	○	○
K81	Date Format	[1]	○	○
K82	Time Format	[1]	○	○
K83	Daylight Saving Time (Summer time)	[1]	○	○
K84	(Start date)	[90]	○	○
K85	(End date)	[90]	○	○
K91	Shortcut Key Function for ⟨ in Running Mode (Selection screen)	[1]	○	○
K92	Shortcut Key Function for ⟩ in Running Mode (Selection screen)	[1]	○	○

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Table 5.27 List of data format numbers (S codes)

Code	Name	Format number	Support	
			HVAC	AQUA
S01	Frequency Command (p.u.)	[29]	O	O
S05	Frequency Command	[22]	O	O
S06	Run Command	[14]	O	O
S07	Universal DO	[15]	O	O
S08	Acceleration Time F07	[3]	O	O
S09	Deceleration Time F08	[3]	O	O
S10	Torque Limiter 1 (Driving)	[6]	O	O
S11	Torque Limiter 1 (Braking)	[6]	O	O
S12	Universal Ao	[29]	O	O
S13	PID Command	[29]	O	O
S14	Alarm Reset Command	[1]	O	O
S19	Speed Command	[2]	O	O
S31	Ext PID Command 1	[29]	O	O
S32	Ext PID Command 2	[29]	O	O
S33	Ext PID Command 3	[29]	O	O
S90	Current Year and Month	[85]	O	O
S91	Current Day and Hour	[86]	O	O
S92	Current Minute and Second	[87]	O	O
S93	Write Clock Data	[1]	O	O

Table 5.28 List of data format numbers (M codes)

Code	Name	Format number	Support	
			HVAC	AQUA
M01	Frequency Reference (p.u.) (Final command)	[29]	O	O
M05	Frequency Reference (Final command)	[22]	O	O
M06	Output Frequency 1(p.u.)	[29]	O	O
M07	Torque Value	[6]	O	O
M09	Output Frequency 1	[23] (FGI)	O	O
		[22] (RTU)	O	O
		[22] (BUS) *1	O	O
M10	Input Power	[5]	O	O
M11	Output Current Effective Value	[5]	O	O
M12	Output Voltage Effective Value	[3]	O	O
M13	Run Command (Final command)	[14]	O	O
M14	Running Status	[16]	O	O
M15	General-purpose Output Terminal Information	[15]	O	O
M16	Alarm Contents (Latest)	[10]	O	O
M17	(Last)	[10]	O	O
M18	(2nd last)	[10]	O	O
M19	(3rd last)	[10]	O	O
M20	Cumulative Run Time	[1]	O	O

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option.

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Table 5.28 List of data format numbers (M codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
M21	DC Link Bus Voltage	[1]	○	○
M22	Motor Temperature	[2]	×	×
M23	Model Code	[17]	○	○
M24	Capacity Code	[11]	○	○
M25	ROM Version	[35]	○	○
M26	Transmission Error Transaction Code	[20]	○	○
M27	Frequency Command on Alarm (p.u.) (Final command)	[29]	○	○
M31	Frequency Command on Alarm (Final command)	[22]	○	○
M32	Output Frequency 1 on Alarm (p.u.)	[29]	○	○
M33	Output Torque on Alarm	[6]	○	○
M35	Output Frequency 1 on Alarm	[23] (FGI)	○	○
		[22] (RTU)	○	○
		[22] (BUS) *1	○	○
M36	Input Power on Alarm	[5]	○	○
M37	Output Current Effective Value on Alarm	[5]	○	○
M38	Output Voltage Effective Value on Alarm	[3]	○	○
M39	Run Command on Alarm	[14]	○	○
M40	Running Status on Alarm	[16]	○	○
M41	Output Terminal Information on Alarm	[15]	○	○
M42	Cumulative Operation Time on Alarm	[1]	○	○
M43	DC Link Bus Voltage on Alarm	[1]	○	○
M44	Inverter Internal Air Temperature on Alarm	[1]	○	○
M45	Heat Sink Temperature on Alarm	[1]	○	○
M46	Life of Main Circuit Capacitor	[3]	○	○
M47	Life of Electrolytic Capacitor on Printed Circuit Board	[74]	○	○
M48	Life of Cooling Fan	[74]	○	○
M49	Input Terminal Voltage [12] (p.u.)	[29]	○	○
M50	Input Terminal Current [C1] (p.u.)	[29]	○	○
M52	Input Terminal Voltage [32] (p.u.)	[29]	○	○
M53	Input Terminal Voltage [C2] (p.u.)	[29]	○	○
M54	Input Terminal Voltage [V2] (p.u.)	[29]	○	○
M61	Inverter Internal Air Temperature	[1]	○	○
M62	Heat Sink Temperature	[1]	○	○
M63	Load Factor	[6]	○	○
M64	Motor Output	[6]	○	○
M65	Motor Output on Alarm	[29]	○	○
M66	Speed Detection	[29]	○	○
M67	Transmission Error Transaction Code (RS-485 port 2)	[20]	○	○
M68	PID Final Command	[29]	○	○
M69	Inverter Rated Current	[24] (FGI)	○	○
		[19] (RTU)	○	○
		[24] (BUS) *1	○	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option.

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Table 5.28 List of data format numbers (M codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
M70	Running Status 2	[44]	○	○
M71	Input Terminal Information	[14]	○	○
M72	PID Feedback Value	[29]	○	○
M73	PID Output	[29]	○	○
M74	Running Situation 2	[76]	○	○
M76	Service Life of DC Link Bus Capacitor (Elapsed time)	[74]	○	○
M77	(Remaining time)	[74]	○	○
M78	Rotation Speed Command	[2]	○	○
M79	Rotation Speed	[2]	○	○
M81	Remaining Time Before The Next Motor 1 Maintenance	[74]	○	○
M85	Remaining Startup Times Before The Next Maintenance	[1]	○	○
M86	Light Alarm Contents (Latest)	[41]	○	○
M87	(Last)	[41]	○	○
M88	(2nd last)	[41]	○	○
M89	(3rd last)	[41]	○	○

Table 5.29 List of data format numbers (W codes)

Code	Name	Format number	Support	
			HVAC	AQUA
W01	Running Status	[16]	○	○
W02	Frequency Reference	[22]	○	○
W03	Output Frequency (Before slip compensation)	[22]	○	○
W04	Output Frequency (After slip compensation)	[22]	○	○
W05	Output Current	[24] (FGI)	○	○
		[19] (RTU)	○	○
		[24] (BUS) *1	○	○
W06	Output Voltage	[3]	○	○
W07	Torque	[2]	○	○
W08	Motor Speed	[37]	○	○
W09	Load Shaft Speed	[37]	○	○
W10	Line Speed	[37]	×	×
W11	PID Process Command	[12]	○	○
W12	PID Feedback Value	[12]	○	○
W13	Torque Limiter Value A	[2]	○	○
W14	Torque Limiter Value B	[2]	○	○
W15	Ratio Value	[5]	×	×
W16	Rotation Speed Command Value	[37]	○	○
W17	Load Shaft Speed Command Value	[37]	○	○
W21	Input Power	[24]	○	○
W22	Motor Output	[24]	○	○
W23	Load Factor	[2]	○	○
W28	Run Command Source	[67]	○	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option.

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Table 5.29 List of data format numbers (W codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
W29	Frequency and PID Command Source	[68]	○	○
W30	Speed at Percentage	[5]	○	○
W31	Speed Set Value at Percentage	[5]	○	○
W32	PID Output	[4]	○	○
W33	Analog Input Monitor	[12]	○	○
W35	Terminal [32] Input Voltage	[4]	○	○
W36	Terminal [C2] Input Current	[4]	○	○
W37	Terminal [AO] Output Voltage	[4]	○	○
W38	Terminal [CS] Output Current	[3]	○	○
W39	Terminal [X7] Pulse Input Monitor	[6]	×	×
W40	Control Circuit Terminal (Input)	[43]	○	○
W41	(Output)	[15]	○	○
W42	Communications Control Signal (Input)	[14]	○	○
W43	(Output)	[15]	○	○
W44	Terminal [12] Input Voltage	[4]	○	○
W45	Terminal [C1] Input Current	[4]	○	○
W46	Terminal [FM1] Output Voltage	[3]	○	○
W47	Terminal [FM2] Output Voltage	[3]	○	○
W49	Terminal [V2] Input Voltage	[4]	○	○
W50	Terminal [FM1] Output Current	[3]	○	○
W65	Terminal [FM2] Output Current	[3]	○	○
W67	Cumulative Run Time of Capacitors on Printed Circuit Boards	[74]	○	○
W68	Cumulative Run Time of Cooling Fan	[74]	○	○
W70	Cumulative Run Time	[1]	○	○
W71	DC Link Bus Voltage	[1]	○	○
W72	Internal Air Highest Temperature	[1]	○	○
W73	Heat Sink Maximum Temperature	[1]	○	○
W74	Maximum Effective Current Value	[24] (FGI)	○	○
		[19] (RTU)	○	○
		[24] (BUS) *1	○	○
W75	Main Circuit Capacitor's Capacity	[3]	○	○
W78	Number of Startups	[1]	○	○
W81	Integrating Electric Power	[93]	○	○
W82	Data Used Integrating Electric Power	[45]	○	○
W83	Number of RS-485 Errors (standard RJ-45 or port 1)	[1]	○	○
W84	Contents of RS-485 Error (standard RJ-45 or port 1)	[20]	○	○
W85	Number of RS-485 Errors (option or port 2)	[1]	○	○
W86	Number of Option 2 Errors (B-port)	[1]	○	○
W87	Inverter's ROM Version	[35]	○	○
W89	Remote/Multi-function Keypad's ROM Version	[35]	○	○
W90	Option 1 (A-port) ROM Version	[35]	○	○
W91	Option 2 (B-port) ROM Version	[35]	○	○
W92	Option 3 (C-port) ROM Version	[35]	○	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option.

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Table 5.29 List of data format numbers (W codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
W94	Contents of RS-485 Error (option or port 2)	[20]	○	○
W95	Number of Option 1 Errors (A-port)	[1]	○	○
W96	Contents of Option 1 Errors (A-port)	[1]	○	○
W97	Contents of Option 2 Errors (B-port)	[1]	○	○
W98	Number of Option 3 Errors (C-port)	[1]	○	○
W99	Contents of Option 3 Errors (C-port)	[1]	○	○

Table 5.29-1 List of data format numbers (W1 codes)

Code	Name	Format number	Support	
			HVAC	AQUA
W101	Current Year and Month	[85]	○	○
W102	Current Day and Hour	[86]	○	○
W103	Current Minute and Second	[87]	○	○
W105	Output Current (U phase)	[24]	○	○
W106	Output Current (V phase)	[24]	○	○
W107	Output Current (W phase)	[24]	○	○
W167	Life Expectancy of Electrolytic Capacitor on PCB	[74]	○	○
W168	Life Expectancy of Cooling Fan	[74]	○	○
W170	Cumulative Run Time	[74]	○	○
W181	Input Watt-hour	[24]	○	○

Table 5.29-2 List of data format numbers (W2 codes)

Code	Name	Format number	Support	
			HVAC	AQUA
W202	PID1 Command	[12]	○	○
W203	PID1 Feedback	[12]	○	○
W205	PID2 Command	[12]	○	○
W206	PID2 Feedback	[12]	○	○
W212	External PID1 Final Command (SV)	[12]	○	○
W213	External PID1 Final Feedback (PV)	[12]	○	○
W214	External PID1 Command (SV)	[12]	○	○
W215	External PID1 Feedback (PV)	[12]	○	○
W217	External PID1 Manual Command	[6]	○	○
W218	External PID1 Final Output	[4]	○	○
W224	External PID2 Command	[12]	○	○
W225	External PID2 Feedback	[12]	○	○
W227	External PID2 Manual Command	[6]	○	○
W228	External PID2 Final Output	[4]	○	○
W234	External PID3 Command	[12]	○	○
W235	External PID3 Feedback	[12]	○	○
W237	External PID3 Manual Command	[6]	○	○
W238	External PID3 Final Output	[4]	○	○

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Table 5.29-2 List of data format numbers (W2 codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
W250	Mutual Operation - Slave Unit 1 Output frequency (Before slip compensation)	[22]	×	○
W251	Output current	[24]	×	○
W252	Power consumption	[24]	×	○
W253	Alarm content (Latest)	[10]	×	○
W255	Mutual Operation - Slave Unit 2 Output frequency (Before slip compensation)	[22]	×	○
W256	Output current	[24]	×	○
W257	Power consumption	[24]	×	○
W258	Alarm content (Latest)	[10]	×	○

Table 5.29-3 List of data format numbers (W3 codes)

Code	Name	Format number	Support	
			HVAC	AQUA
W301	Input Watt-hour Monitor Interval	[1]	○	○
W302	Input Watt-hour Monitor Start Year and Month	[85]	○	○
W303	Input Watt-hour Monitor Start Day and Time	[86]	○	○
W304	Input Watt-hour Monitor 1	[45]	○	○
W305	Input Watt-hour Monitor 2	[45]	○	○
W306	Input Watt-hour Monitor 3	[45]	○	○
W307	Input Watt-hour Monitor 4	[45]	○	○
W308	Input Watt-hour Monitor 5	[45]	○	○
W309	Input Watt-hour Monitor 6	[45]	○	○
W310	Input Watt-hour Monitor 7	[45]	○	○
W311	Input Watt-hour Monitor 8	[45]	○	○
W312	Input Watt-hour Monitor 9	[45]	○	○
W313	Input Watt-hour Monitor 10	[45]	○	○
W314	Input Watt-hour Monitor 11	[45]	○	○
W315	Input Watt-hour Monitor 12	[45]	○	○
W316	Input Watt-hour Monitor 13	[45]	○	○
W317	Input Watt-hour Monitor 14	[45]	○	○
W318	Input Watt-hour Monitor 15	[45]	○	○
W319	Input Watt-hour Monitor 16	[45]	○	○
W320	Input Watt-hour Monitor 17	[45]	○	○
W321	Input Watt-hour Monitor 18	[45]	○	○
W322	Input Watt-hour Monitor 19	[45]	○	○
W323	Input Watt-hour Monitor 20	[45]	○	○
W324	Input Watt-hour Monitor 21	[45]	○	○
W325	Input Watt-hour Monitor 22	[45]	○	○
W326	Input Watt-hour Monitor 23	[45]	○	○
W327	Input Watt-hour Monitor 24	[45]	○	○
W328	Input Watt-hour Monitor 25	[45]	○	○
W329	Input Watt-hour Monitor 26	[45]	○	○
W330	Input Watt-hour Monitor 27	[45]	○	○
W331	Input Watt-hour Monitor 28	[45]	○	○

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Table 5.29-3 List of data format numbers (W3 codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
W332	Input Watt-hour Monitor 29	[45]	○	○
W333	Input Watt-hour Monitor 30	[45]	○	○
W334	Input Watt-hour Monitor 31	[45]	○	○
W335	Input Watt-hour Monitor 32	[45]	○	○
W336	Input Watt-hour Monitor 33	[45]	○	○
W337	Input Watt-hour Monitor 34	[45]	○	○
W338	Input Watt-hour Monitor 35	[45]	○	○
W339	Input Watt-hour Monitor 36	[45]	○	○
W340	Input Watt-hour Monitor 37	[45]	○	○
W341	Input Watt-hour Monitor 38	[45]	○	○
W342	Input Watt-hour Monitor 39	[45]	○	○
W343	Input Watt-hour Monitor 40	[45]	○	○
W344	Input Watt-hour Monitor 41	[45]	○	○
W345	Input Watt-hour Monitor 42	[45]	○	○
W346	Input Watt-hour Monitor 43	[45]	○	○
W347	Input Watt-hour Monitor 44	[45]	○	○
W348	Input Watt-hour Monitor 45	[45]	○	○
W349	Input Watt-hour Monitor 46	[45]	○	○
W350	Input Watt-hour Monitor 47	[45]	○	○
W351	Input Watt-hour Monitor 48	[45]	○	○
W352	Run Time Monitor 1	[45]	○	○
W353	Run Time Monitor 2	[45]	○	○
W354	Run Time Monitor 3	[45]	○	○
W355	Run Time Monitor 4	[45]	○	○
W356	Run Time Monitor 5	[45]	○	○
W357	Run Time Monitor 6	[45]	○	○
W358	Run Time Monitor 7	[45]	○	○
W359	Run Time Monitor 8	[45]	○	○
W360	Run Time Monitor 9	[45]	○	○
W361	Run Time Monitor 10	[45]	○	○
W362	Run Time Monitor 11	[45]	○	○
W363	Run Time Monitor 12	[45]	○	○
W364	Run Time Monitor 13	[45]	○	○
W365	Run Time Monitor 14	[45]	○	○
W366	Run Time Monitor 15	[45]	○	○
W367	Run Time Monitor 16	[45]	○	○
W368	Run Time Monitor 17	[45]	○	○
W369	Run Time Monitor 18	[45]	○	○
W370	Run Time Monitor 19	[45]	○	○
W371	Run Time Monitor 20	[45]	○	○
W372	Run Time Monitor 21	[45]	○	○
W373	Run Time Monitor 22	[45]	○	○
W374	Run Time Monitor 23	[45]	○	○
W375	Run Time Monitor 24	[45]	○	○

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Table 5.29-3 List of data format numbers (W3 codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
W376	Run Time Monitor 25	[45]	○	○
W377	Run Time Monitor 26	[45]	○	○
W378	Run Time Monitor 27	[45]	○	○
W379	Run Time Monitor 28	[45]	○	○
W380	Run Time Monitor 29	[45]	○	○
W381	Run Time Monitor 30	[45]	○	○
W382	Run Time Monitor 31	[45]	○	○
W383	Run Time Monitor 32	[45]	○	○
W384	Run Time Monitor 33	[45]	○	○
W385	Run Time Monitor 34	[45]	○	○
W386	Run Time Monitor 35	[45]	○	○
W387	Run Time Monitor 36	[45]	○	○
W388	Run Time Monitor 37	[45]	○	○
W389	Run Time Monitor 38	[45]	○	○
W390	Run Time Monitor 39	[45]	○	○
W391	Run Time Monitor 40	[45]	○	○
W392	Run Time Monitor 41	[45]	○	○
W393	Run Time Monitor 42	[45]	○	○
W394	Run Time Monitor 43	[45]	○	○
W395	Run Time Monitor 44	[45]	○	○
W396	Run Time Monitor 45	[45]	○	○
W397	Run Time Monitor 46	[45]	○	○
W398	Run Time Monitor 47	[45]	○	○
W399	Run Time Monitor 48	[45]	○	○

Table 5.30 List of data format numbers (X codes)

Code	Name		Format number	Support	
				HVAC	AQUA
X00	Alarm History	(Latest)	[41]	○	○
X01	Multiple Alarm 1	(Latest)	[40]	○	○
X02	Multiple Alarm 2	(Latest)	[40]	○	○
X03	Sub Code	(Latest)	[1]	○	○
X04	Multiple Alarm 1 Sub Code	(Latest)	[1]	○	○
X05	Alarm History		[41]	○	○
X06	Multiple Alarm 1	(Last)	[40]	○	○
X07	Multiple Alarm 2	(Last)	[40]	○	○
X08	Sub Code	(Last)	[1]	○	○
X09	Multiple Alarm 1 Sub Code	(Last)	[1]	○	○
X10	Alarm History	(2nd last)	[41]	○	○
X11	Multiple Alarm 1	(2nd last)	[40]	○	○
X12	Multiple Alarm 2	(2nd last)	[40]	○	○
X13	Sub Code	(2nd last)	[1]	○	○
X14	Multiple Alarm 1 Sub Code	(2nd last)	[1]	○	○

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Table 5.30 List of data format numbers (X codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
X15	Alarm History (3rd last)	[41]	○	○
X16	Multiple Alarm 1 (3rd last)	[40]	○	○
X17	Multiple Alarm 2 (3rd last)	[40]	○	○
X18	Sub Code (3rd last)	[1]	○	○
X19	Multiple Alarm 1 Sub Code (3rd last)	[1]	○	○
X20	Latest Info. on Alarm (Output frequency)	[22]	○	○
X21	(Output current)	[24] (FGI)	○	○
		[19] (RTU)	○	○
		[24] (BUS) *1	○	○
X22	(Output voltage)	[1]	○	○
X23	(Torque)	[2]	○	○
X24	(Reference frequency)	[22]	○	○
X25	(Running situation)	[16]	○	○
X26	(Cumulative run time)	[1]	○	○
X27	(Number of startups)	[1]	○	○
X28	(DC link bus voltage)	[1]	○	○
X29	(Internal air temperature)	[1]	○	○
X30	(Heat sink temperature)	[1]	○	○
X31	(Control circuit terminal (input))	[43]	○	○
X32	(Control circuit terminal (output))	[15]	○	○
X33	(Communications control signal (input))	[14]	○	○
X34	(Communications control signal (output))	[15]	○	○
X35	(Input power on alarm)	[24]	○	○
X36	(Running situation 2)	[76]	○	○
X37	(Speed detection)	[29]	○	○
X38	(Running situation 3, running status 2)	[44]	○	○
X54	Light Alarm Contents (4th last, 1st one)	[41]	○	○
X55	(5th last, 1st one)	[41]	○	○
X60	Last Info. on Alarm (Output frequency)	[22]	○	○
X61	(Output current)	[24] (FGI)	○	○
		[19] (RTU)	○	○
		[24] (BUS) *1	○	○
X62	(Output voltage)	[1]	○	○
X63	(Torque)	[2]	○	○
X64	(Reference frequency)	[22]	○	○
X65	(Running situation)	[16]	○	○
X66	(Cumulative run time)	[1]	○	○
X67	(Number of startups)	[1]	○	○
X68	(DC link bus voltage)	[1]	○	○
X69	(Internal air temperature)	[1]	○	○
X70	(Heat sink temperature)	[1]	○	○
X71	(Control circuit terminal, input)	[43]	○	○
X72	(Control circuit terminal, output)	[15]	○	○
X73	(Communications control signal, input)	[14]	○	○

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Table 5.30 List of data format numbers (X codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
X74	Last Info. on Alarm (Communications control signal, output)	[15]	○	○
X76	(Running situation 2)	[76]	○	○
X77	(Speed detection)	[29]	○	○
X78	(Running situation 3, Running status 2)	[44]	○	○
X89	Customizable Logic (Digital input/output)	[95]	○	○
X90	(Timer monitor)	[5]	○	○
X91	(Analog input 1)	[12]	○	○
X92	(Analog input 2)	[12]	○	○
X93	(Analog output)	[12]	○	○
X94	Relay Output Terminal Info.	[91]	○	○
X95	Flowrate Sensor Monitor	[12]	×	○
X96	Terminal (CS2) Output Current	[3]	○	○
X97	Terminal (PTC) Input Voltage	[4]	○	○
X98	Pt Option Detection Temperature (ch1)	[4]	○	○
X99	Pt Option Detection Temperature (ch2)	[4]	○	○

Table 5.30-1 List of data format numbers (X1 codes)

Code	Name	Format number	Support	
			HVAC	AQUA
X105	On alarm year/month (Latest)	[85]	○	○
X106	On alarm day/hour (Latest)	[86]	○	○
X107	On alarm minute/second (Latest)	[87]	○	○
X115	On alarm year/month (Last)	[85]	○	○
X116	On alarm day/hour (Last)	[86]	○	○
X117	On alarm minute/second (Last)	[87]	○	○
X125	On alarm year/month (2nd last)	[85]	○	○
X126	On alarm day/hour (2nd last)	[86]	○	○
X127	On alarm minute/second (2nd last)	[87]	○	○
X135	On alarm year/month (3rd last)	[85]	○	○
X136	On alarm day/hour (3rd last)	[86]	○	○
X137	On alarm minute/second (3rd last)	[87]	○	○
X140	Alarm history (4th last, 1st one)	[41]	○	○
X145	On alarm year/month (4th last)	[85]	○	○
X146	On alarm day/hour (4th last)	[86]	○	○
X147	On alarm minute/second (4th last)	[87]	○	○
X150	Alarm history (5th last, 1st one)	[41]	○	○
X155	On alarm year/month (5th last)	[85]	○	○
X156	On alarm day/hour (5th last)	[86]	○	○
X157	On alarm minute/second (5th last)	[87]	○	○
X160	Alarm history (6th last, 1st one)	[41]	○	○
X165	On alarm year/month (6th last)	[85]	○	○
X166	On alarm day/hour (6th last)	[86]	○	○
X167	On alarm minute/second (6th last)	[87]	○	○

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Table 5.30-1 List of data format numbers (X1 codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
X170	Alarm history (7th last, 1st one)	[41]	○	○
X175	On alarm year/month (7th last)	[85]	○	○
X176	On alarm day/hour (7th last)	[86]	○	○
X177	On alarm minute/second (7th last)	[87]	○	○
X180	Alarm history (8th last, 1st one)	[41]	○	○
X185	On alarm year/month (8th last)	[85]	○	○
X186	On alarm day/hour (8th last)	[86]	○	○
X187	On alarm minute/second (8th last)	[87]	○	○
X190	Alarm history (9th last, 1st one)	[41]	○	○
X195	On alarm year/month (9th last)	[85]	○	○
X196	On alarm day/hour (9th last)	[86]	○	○
X197	On alarm minute/second (9th last)	[87]	○	○

Table 5.31 List of data format numbers (Z codes)

Code	Name	Format number	Support	
			HVAC	AQUA
Z00	Info. on Alarm (2nd last) (Output frequency)	[22]	○	○
Z01	(Output current)	[24] (FGI)	○	○
		[19] (RTU)	○	○
		[24] (BUS) *1	○	○
Z02	(Output voltage)	[1]	○	○
Z03	(Torque)	[2]	○	○
Z04	(Reference frequency)	[22]	○	○
Z05	(Running situation)	[16]	○	○
Z06	(Cumulative run time)	[1]	○	○
Z07	(Number of startups)	[1]	○	○
Z08	(DC link bus voltage)	[1]	○	○
Z09	(Internal air temperature)	[1]	○	○
Z10	(Heat sink temperature)	[1]	○	○
Z11	(Control circuit terminal, input)	[43]	○	○
Z12	(Control circuit terminal, output)	[15]	○	○
Z13	(Communications control signal, input)	[14]	○	○
Z14	(Communications control signal, output)	[15]	○	○
Z16	(Running situation 2)	[76]	○	○
Z17	(Speed detection)	[29]	○	○
Z18	(Running situation 3, running status 2)	[44]	○	○
Z40	Cumulative Run Time of Motor 1	[74]	○	○
Z48	Retry History (Latest)	[41]	○	○
Z49	(Last)	[41]	○	○
Z50	Info. on Alarm (3rd last) (Output frequency)	[22]	○	○
Z51	(Output current)	[24] (FGI)	○	○
		[19] (RTU)	○	○
		[24] (BUS) *1	○	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option.

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Table 5.31 List of data format numbers (Z codes) (Continued)

Code	Name	Format number	Support	
			HVAC	AQUA
Z52	Info. on Alarm (3rd last) (Output voltage)	[1]	○	○
Z53	(Torque)	[2]	○	○
Z54	(Reference frequency)	[22]	○	○
Z55	(Running situation)	[16]	○	○
Z56	(Cumulative run time)	[1]	○	○
Z57	(Number of startups)	[1]	○	○
Z58	(DC link bus voltage)	[1]	○	○
Z59	(Internal air temperature)	[1]	○	○
Z60	(Heat sink temperature)	[1]	○	○
Z61	(Control circuit terminal, input)	[43]	○	○
Z62	(Control circuit terminal, output)	[15]	○	○
Z63	(Communications control signal, input)	[14]	○	○
Z64	(Communications control signal, output)	[15]	○	○
Z66	(Running situation 2)	[76]	○	○
Z67	(Speed detection)	[29]	○	○
Z68	(Running situation 3, running status 2)	[44]	○	○
Z80	Speed Detection	[2]	○	○
Z81	Torque Real Value	[6]	○	○
Z82	Load Factor	[6]	○	○
Z83	Motor Output	[6]	○	○
Z84	Output Current	[24] (FGI)	○	○
		[19] (RTU)	○	○
		[24] (BUS) *1	○	○
Z85	PID Feedback Value	[12]	○	○
Z86	Input Power	[24]	○	○
Z87	PID Output	[4]	○	○

*1 BUS: The field bus option format is selected. For details about the field bus option, see the instruction manual for each field bus option.

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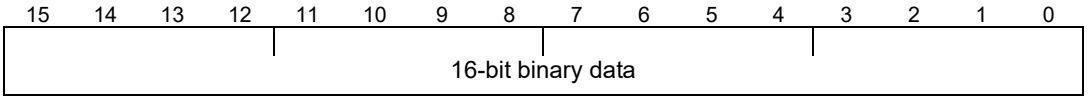
5.2.2 Data format specifications

The data in the data fields of a communications frame are 16 bits long, binary data, as shown below.



For the convenience of description, 16-bit data is expressed in hexadecimal with one upper-order byte (eight bits from 15 to 8) and one lower-order byte (eight bits from 7 to 0).

For example, the following data is 1234H in hexadecimal and expressed as | 12_H | 34_H | .

0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0

As listed below, read "values" for "words" in function code data.

Word ⇒ Value	Function codes to apply
OFF ⇒ 0	F05, F11, F22, E34, E85, H04, H50, H52, H78, H79, H91, J114, J158, J160, J177, J178, J183, J184, J189, J190, J198, J214, J258, J260, J277, J278, J436, J461, J462, J465, J467, J514, J614, J664, y08, y18, o40-o59, K02, K03
Inherit ⇒ 0	E82, E83, E84, E86, H14, H64, H70, H118, J144, J145, J455, J458
Decel ⇒ 0	E65
Meas ⇒ 0	H42, H47
Auto ⇒ 32767	H14, H16, H92, H93, H114, J129, J130, J150, J229, J230, J250, J529, J530, J629, J630, J679, J680
Cont ⇒ 32767	J128, J228
infinit ⇒ 32767	H04
Inherit ⇒ 32767	J118, J119, J218, J219, J450, J452, J457, J459, J460
OFF ⇒ 32767	F40, F41, E16, E17, E65, H70, J122, J124, J147, J157, J164, J165, J191, J222, J224, J247, J257, J522, J524, J622, J624, J672, J674
on/off ⇒ 32767	J510, J610, J660
Test ⇒ 32767	J436

Data format [1] Integer data (positive): Minimum step 1

(Example) When F05 (base) frequency voltage = 200 V

200 = $00C8_H$ Consequently ⇒ | 00_H | $C8_H$ |

Data format [2] Integer data (positive/negative): Minimum step 1

(Example) When the value is -20

-20 = $FFEC_H$ Consequently, ⇒ | FF_H | EC_H |

Data format [3] Decimal data (positive): Minimum step 0.1

(Example) When F17 (gain frequency set signal) = 100.0%

100.0 x 10 = 1000 = $03E8_H$ Consequently, ⇒ | 03_H | $E8_H$ |

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Data format [4] Decimal data (positive/negative): Minimum step 0.1

(Example) When C31 (analog input offset adjustment) = -5.0%

-5.0 x 10 = -50 = $FFCE_H$ Consequently, ⇒

FF_H	CE_H

Data format [5] Decimal data (positive): Minimum step 0.01

(Example) C05 (multistep frequency) = 50.25 Hz

50.25 x 100 =5025 =$13A1_H$ Consequently, ⇒

13_H	$A1_H$

Data format [6] Decimal data (positive/negative): Minimum step 0.01

(Example) When M07 (actual torque value) = -85.38%

-85.38 x 100 =-8538 = $DEA6_H$ Consequently, ⇒

DE_H	$A6_H$

Data format [7] Decimal data (positive): Minimum step 0.001

(Example) When F51(electronic thermal (permissible loss)) = 0.105 kW

0.105 x 1000 = 105 = 0069_H Consequently, ⇒

00_H	69_H

Data format [8] Decimal data (positive/negative): Minimum step 0.001

(Example) When the data is -1.234

-1.234 x 1000 = -1234 = $FB2E_H$ Consequently, ⇒

FB_H	$2E_H$

Data format [10] Alarm codes

Table 5.32 List of alarm codes

Code	Description		Code	Description	
0	No alarm	---	54	Hardware error	ErH
1	Overcurrent (during acceleration)	OC1	57	EN circuit error	ECF
2	Overcurrent (during deceleration)	OC2	58	PID feedback disconnection detected	CoF
3	Overcurrent (during constant speed operation)	OC3	59	DB transistor trouble	dbA
5	Ground fault	EF	65	Customizable logic error	ECL
6	Overvoltage (during acceleration)	OV1	66	PID control 1 feedback error detection	PV1
7	Overvoltage (during deceleration)	OV2	67	PID control 2 feedback error detection	PV2
8	Overvoltage (during constant speed operation or stopping)	OV3	81	Dry pump protection	Pdr
10	Undervoltage	LV	82	Control of maximum starts per hour	roC
11	Input phase loss	Lin	83	End of curve protection	PoL
14	Fuse blown	FUS	84	Anti jam	rLo
16	Charging circuit fault	PbF	85	Filter clogging error	FoL
17	Heat sink overheat	OH1	91	External PID control 1 feedback error detection	PVA
18	External alarm	OH2	92	External PID control 2 feedback error detection	PVb
19	Internal air overheat	OH3	93	External PID control 3 feedback error detection	PVC
20	Motor protection (PTC/NTC thermistor)	OH4	100	DC fan lock detected	FAL
22	Braking resistor overheat	dbH	101	Motor overload warning	OL
23	Motor overload	OL1	102	Cooling fin overheat warning	OH
24	Motor overload: motor 2	OL2	103	Life warning	Lif
25	Inverter overload	OLU	104	Command loss	rEF
27	Over speed protection	OS	105	PID warning output	Pid
28	PG disconnection	PG	106	Low torque detected	UTL
29	NTC disconnection error	nrb	107	Thermistor detected (PTC)	PTC
31	Memory error	Er1	108	Machine life (accumulated operation hours)	rTE
32	Keypad communications error	Er2	109	Machine life (No. of starting times)	CnT
33	CPU error	Er3	166	PID control 1 warning output	PA1
34	Option communications error	Er4	167	PID control 2 warning output	PA2
35	Option error	Er5	190	Mutual operation slave alarm	SLA
36	Run operation error	Er6	191	External PID control 1 warning output	PAA
37	Tuning error	Er7	192	External PID control 2 warning output	PAb
38	RS-485 communications error (communications port 1)	Er8	193	External PID control 3 warning output	PAC
44	Motor overload: motor 3	OL3	250	Low battery	Lob
45	Motor overload: motor 4	OL4	251	Date information lost	dtL
46	Output phaseloss	OPL	252	Fire mode	Fod
47	Following error, excessive speed deviation	ErE	253	Password protection	LoK
51	Data save error on insufficient voltage	ErF	254	Simulated error	Err
53	RS-485 communications error (Option/Communications port 2)	ErP			

(Example) In the case of overvoltage (during acceleration) (OV1*)*

$6 = 0006_H$ Consequently, ⇒

00_H	06_H

Data format [11] Capacity code (unit: kW)

As shown in the table below, the capacity (kW) is multiplied by 100.

Table 5.33 Capacities and data

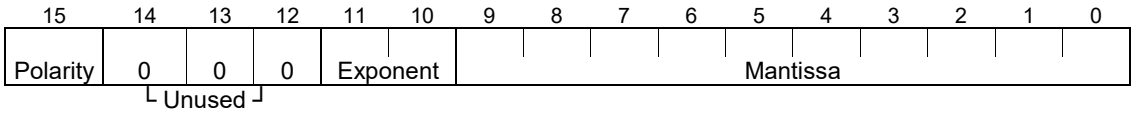
Capacity (kW)	Data	Capacity (kW)	Data	Capacity (kW)	Data
0.06	6	22	2200	280	28000
0.1	10	30	3000	315	31500
0.2	20	37	3700	355	35500
0.4	40	45	4500	400	40000
0.75	75	55	5500	450	45000
1.5	150	75	7500	500	50000
2.2	220	90	9000	550	55000
3.7	370	110	11000	600	60000
5.5	550	132	13200	650	60650
7.5	750	160	16000	700	60700
11	1100	200	20000	750	60750
15	1500	220	22000	800	60800
18.5	1850	250	25000	1000	61000

(Example) When the capacity is 2.2 kW

2.20 x 100 = 220 = $00DC_H$ Consequently, ⇒

00_H	DC_H

Data format [12] Floating point data (accel./decal. time, PID display coefficient)



Polarity: 0 → Positive (+), 1 → Negative (-) Exponent: 0 to 3 Mantissa: 1 to 999

Value expressed in this form = (polarity) Mantissa x (Exponent - 2) power of 10

Value	Mantissa	Exponent	(Exponent - 2) power of 10
0.01 to 9.99	1 to 999	0	0.01
10.0 to 99.9	100 to 999	1	0.1
100 to 999	100 to 999	2	1
1000 to 9990	100 to 999	3	10

(Example) When F07 (acceleration time 1) = 20.0 seconds

20.0 = 200 x 0.1 => $0000\ 0100\ 1100\ 1000_b = 04C8_H$ ⇒ Consequently,

04_H	$C8_H$

Data format [14] Operation command

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RST	XR (REV)	XF (FWD)	0	EN	0	0	X7	X6	X5	X4	X3	X2	X1	REV	FWD
↑	General-purpose input		Unused	EN terminal	General-purpose input									FWD: Forward command	
Alarm reset														REV: Reverse command	

(All bits are turned ON when set to 1.)

(Example) When S06 (operation command) = FWD, X1 = ON

$0000\ 0000\ 0000\ 0101_b = 0005_H$ Consequently, ⇒

00_H	05_H

Data format [15] General-purpose output terminal

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	30	0	0	0	Y5	Y4	Y3	Y2	Y1
Unused	Unused			Unused			↑	Unused			General-purpose output				
							Alarm (general-purpose output)								

(All bits are turned ON when set to 1.)

(Example) When M15 (general-purpose output terminal) = Y1 = ON

$0000\ 0000\ 0000\ 0001_b = 0001_H$ Consequently, ⇒

00_H	01_H

Data format [16] Operation status

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
BUSY	0	0	RL	ALM	DEC	ACC	IL	VL	0	NUV	BRK	INT	EXT	REV	FWD

(All bits are turned ON or become active when set to 1.)

Bit	Symbol	Description	Support		Bit	Symbol	Description	Support	
			HVAC	AQUA				HVAC	AQUA
0	FWD	During forward rotation	○	○	8	IL	During current limiting	○	○
1	REV	During reverse rotation	○	○	9	ACC	During acceleration	○	○
2	EXT	During DC braking (or during pre-exciting)	○	○	10	DEC	During deceleration	○	○
3	INT	Inverter shut down	○	○	11	ALM	Alarm relay (for any fault)	○	○
4	BRK	During braking	○	○	12	RL	Communications effective	○	○
5	NUV	DC link bus voltage established (0 = undervoltage)	○	○	13	0	−	×	×
6	TL	During torque limiting	○	○	14	0	−	×	×
7	VL	During voltage limiting	○	○	15	BUSY	During function code data writing	○	○

*1 The "Support" column indicates whether each inverter type supports the corresponding bit or not. The symbol "O" means the code is supported and the symbol "X" means that the code is not supported (fixed to 0).

Data format [17] Model code

15 14 13 12	11 10 9 8	7 6 5 4	3 2 1 0
Model	Generation	Destination	Input power supply

Table 5.34 List of model codes

Code	1	2	3	4	5	6	7	8	9	A	B	C	D	E
Model	VG	G	P HVAC (AR)	E	C	S	DPS	DGS AQUA (AQ)	H (1667 Hz)	H (3000 Hz)	F	RHC	RHR	Lift
Generation	11 series	7 series	1 series RHR A series RHC C series	Eco PLUS series										
Destination	Japan	Asia	China	Europe	USA	Taiwan								
Input power supply	Single-phase 100V	Single-phase 200V	Three-phase 200V	Three-phase 400V										

(Example) When the inverter type is FRN1.5AR 1 L-4 E

- Destination: Eupope
- Input power supply: 3-phase 400V
- Structure: IP55
- Generation: 1 series
- Model: AR1

Since "model" AR is represented by code 3, "generation" 1 series by code 3, "destination" Europe by 4, and "input power supply" 3-phase 400 V by 4, the model code is 3344_H.

Data format [19] Current value

Current values are decimal data (positive). The minimum step is 0.01 for an inverter capacity of 22 kW (30 HP) or less and 0.1 for an inverter capacity of 30 kW (40 HP) or more.

When inverter capacity is 22 kW (30 HP) or less, any data higher than 655A cannot be written. No correct value can be read out when a direction for write data higher than 655A is issued.

Current data is rounded down on and after the fifth digit inside the inverter. (Ex.: When a writing direction of 107.54A is issued to an inverter with a capacity of 22 kW (30 HP), 107.5A is written.)

(Ex.) When F11 (electronic thermal operation level) = 107.0A (40 HP)

$107.0 \times 10 = 1070 = 042E_H$, consequently ⇒

04_H	$2E_H$

(Ex.) When F11 (electronic thermal operation level) = 3.60A (1 HP)

$3.60 \times 10 = 360 = 0168_H$, consequently ⇒

01_H	68_H

Data format [20] Communications error

Table 5.35 Communications error codes (common to both protocols)

Code	Description	Code	Description
71	Checksum error, CRC error ⇒ No response	73	Framing error, overrun error, buffer full ⇒ No response
72	Parity error ⇒ No response		

Table 5.36 Communications error codes (for Fuji general-purpose inverter protocol)

Code	Description	Code	Description
74	Format error	78	Function code error
75	Command error	79	Write disabled
76	Link priority error	80	Data error
77	Function code data write right error	81	Error during writing

Table 5.37 Communications error codes (for RTU protocol)

Code	Description	Code	Description
1	Improper 'FC'	3	Improper data (range error)
2	Improper address (function code error)	7	NAK (link priority, no right, write disabled)

(Example) In case of an improper address

$2 = 0002_H$ Consequently, ⇒

00_H	02_H

Data format [21] Auto tuning

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	REV	FWD	Data part							

Not used

When FWD is 1, this data is the forward rotation command. When REV is 1, this data is the reverse rotation command. However, if both FWD and REV are 1, the command is not effective. Both FWD and REV are 0 for reading.

(Ex.) When P04 (motor 1 automatic tuning) = 1 (forward rotation),

$0000\ 0001\ 0000\ 0001_b = 0101_H$ Consequently, ⇒

01_H	01_H

Data format [22] Frequency data

Decimal data (positive): Resolution 0.01 Hz

(Ex.) When C05 (multistep frequency 1) = 50.25 Hz

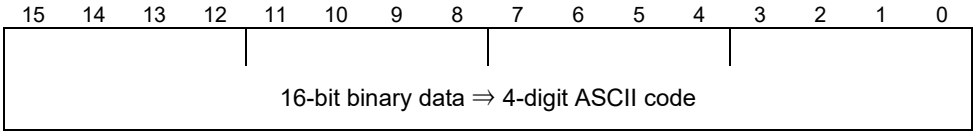
$50.25 \times 100 = 5025 = 13A1_H$, consequently ⇒

13_H	$A1_H$

Data format [23] Polarity + decimal data (positive)

(for Fuji general-purpose inverter protocol)

Decimal data (positive): Resolution 0.01 Hz



For reverse rotation, add a negative sign (-) (ASCII) to the special additional data in the standard frame, or for forward rotation, enter a space (ASCII).

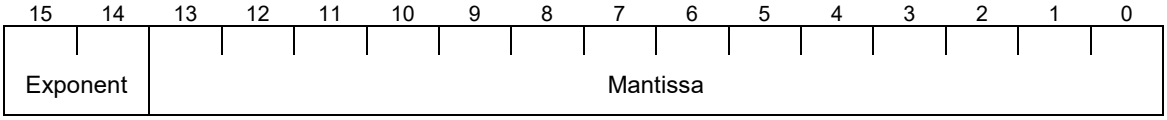
(Example) When maximum frequency = 60 Hz and M09 (output frequency) = 60.00 Hz (forward rotation)

60.00 x 100 = 6000 = 1770_H Consequently, ⇒

	1	7	7	0

(Positive data is in the same data format as data format [5].)

Data format [24] Floating point data



Exponent: 0-3 Mantissa: 1 to 9999

The value expressed by this format = the mantissa × $10^{(exponent-2)}$

Numeric value	Mantissa	Exponent	$10^{(exponent-2)}$
0.00 to 99.99	0 to 9999	0	0.01
100.0 to 999.9	1000 to 9999	1	0.1
1000 to 9999	1000 to 9999	2	1
10000 to 99990	1000 to 9999	3	10

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Data format [25] Capacity code (for HP)

As shown in the table below, the capacity (HP) is multiplied by 100.

Table 5.38 Capacities and data (for HP)

Code	Capacity (HP)	Code	Capacity (HP)	Code	Capacity (HP)
7	0.07 (reserved)	3000	30	40000	400
15	0.15 (reserved)	4000	40	45000	450
25	0.25	5000	50	50000	500
50	0.5	6000	60	60000	600
100	1	7500	75	60700	700
200	2	10000	100	60750	750
300	3	12500	125	60800	800
500	5	15000	150	60850	850
750	7.5	17500	175	60900	900
1000	10	20000	200	60950	950
1500	15	25000	250	61000	1000
2000	20	30000	300	61050	1050
2500	25	35000	350		

(Example) When the capacity is 3 HP

3 x 100 = 300 = $012C_H$ Consequently, ⇒

01_H	$2C_H$

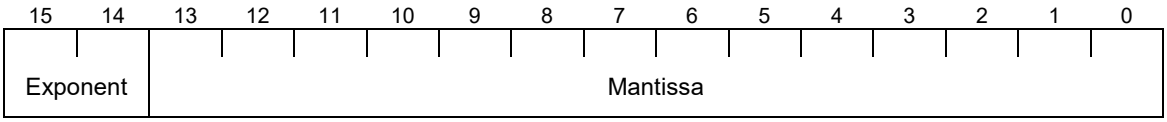
Data format [29] Positive/Negative data of values converted into standard (p.u.) with 20,000

(Example) Speed (frequency) Data of ±20,000/±maximum speed (frequency)

Data format [35] ROM version

Range: 0 to 9999

Data format [37] Floating point data (load rotation speed, etc.)



Exponent: 0-3 Mantissa: 1 to 9999

The value expressed by this format = the mantissa × $10^{(exponent-2)}$

Numeric value	Mantissa	Exponent	$10^{(exponent-2)}$
0.01 to 99.99	1 to 9999	0	0.01
100.0 to 999.9	1000 to 9999	1	0.1
1000 to 9999	1000 to 9999	2	1
10000 to 99990	1000 to 9999	3	10

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Data format [40] Alarm factor

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Alarm caused by multiple factors (1 to 5)				Order of alarm occurrences (1 to 5)				Alarm code (See Table 5.32.)							

Data format [41] Alarm history

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Number of serial occurrences of same alarm								Alarm code (See Table 5.32.)							

Indicates the content of an alarm that has occurred and the number of serial occurrence times of the alarm.

Data format [43] Operation command (for I/O check)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	X7	X6	X5	X4	X3	X2	X1	REV	FWD
Unused						General-purpose input								General-purpose input	

(All bits are turned ON when set to 1.)

Data format [44] Operation status 2

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	IDL	ID	OLP	LIFE	OH	TRY	FAN	KP	OL	IPF	0	RDY	FDT	FAR

(All bits are turned ON or become active when set to 1.)

Bit	Symbol	Description	Support		Bit	Symbol	Description	Support	
			HVAC	AQUA				HVAC	AQUA
0	FAR	Frequency arrival signal	○	○	8	TRY	Retry in operation	○	○
1	FDT	Frequency level detection	○	○	9	OH	Heat sink overheat early warning	○	○
2	RDY	Inverter ready to run	○	○	10	LIFE	Lifetime alarm	○	○
3	SWM2	2nd motor is selected	×	×	11	OLP	Overload prevention control	○	○
4	IPF	Auto-restarting after recovery of power	○	○	12	ID	Current detection	○	○
5	OL	Motor overload early warning	○	○	13	IDL	Low level current detection	×	×
6	KP	Running per keypad	×	×	14	ID2	Current detection 2	×	×
7	FAN	Cooling fan in operation	○	○	15	0	–	×	×

*1 The "Support" column indicates whether each inverter type supports the corresponding bit or not. The symbol "O" means the code is supported and the symbol "X" means that the code is not supported (fixed to 0).

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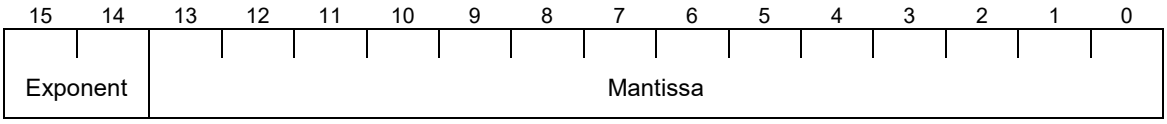
Data format [45] Floating point data



Exponent: 0-3 Mantissa: 0 to 9999

The value expressed by this format = the mantissa × $10^{(\text{exponent-3})}$

Numeric value	Mantissa	Exponent	$10^{(\text{exponent-3})}$
0.000 to 9.999	0 to 9999	0	0.001
10.0 to 99.9	1000 to 9999	1	0.01
100.0 to 999.9	1000 to 9999	2	0.1
1000 to 9999	1000 to 9999	3	1

Data format [67] Operation command source codes

Code	Description	Remarks
0	Keypad operation (Rotating direction: Depends on the terminal input)	Same with the selections for F02
1	Terminal operation	
2	Keypad operation (CW)	
3	Keypad operation (CCW)	
4	Run command 2	
5	Forced operation (Fire mode)	
6 to 19	Reserved	
20	RS-485 channel 1	
21	RS-485 channel 2	
22	Bus option	
23	FRENIC Loader	

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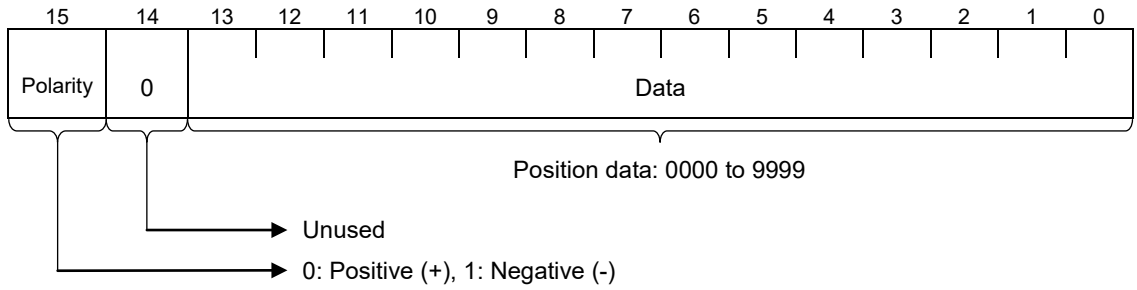
Data format [68] Frequency command source codes

Code	Description	Remarks
0	Keypad key operation	Same with the selections for F01
1	Voltage input (Terminal [12])	
2	Current input (Terminal [C1])	
3	Voltage input (Terminal [12]) + Current input (Terminal [C1])	
4	Inverter body volume	
5	Voltage input (Terminal [V2])	
7	UP/DOWN	
8	Keypad key operation (Balanceless, bumpless functions are activated.)	
11	Digital input (option)	
12	Pulse train input	
20	RS-485 channel 1	
21	RS-485 channel 2	
22	Bus option	
23	FRENIC Loader	
24	Multi-step	
25	JOG	
30	PID TP	
31	PID analog 1	
32	PID analog 2	
33	PID UP/DOWN	
34	PID communications command	
36	PID multistep	
39	Forced operation (Fire mode)	

Data format [73] Integer data (positive/negative sign bit)

Resolution 1 (The high-order digit of position control data)



Data format [74] Integer data (positive): by 10 hours

(Example) M81 (Maintenance remaining hours-M1) = 12340 hours

12340 ÷10 =04D2$_H$ Consequently =>

04$_H$	D2$_H$

Data format [75] Integer data (positive) + [P] Exception for position control

Based on the positive integer data, setting of “-1” is permitted exceptionally. When “-1” is set on the touch probe or the loader, [P] is displayed.

Data format [76] Operating status 2

15	14	13	12	11	10	9	8	7	6	5 4	3 2 1 0
Drive motor type	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Rotation direction limited	Speed limit ON	Reserved	Motor selected	Control system

(Reserved bits should be always "0.")

Signal name	Description	HVAC	AQUA
Control system	Indicates the final control system including set values and terminal conditions. 0: V/f control without slip compensation 1: Dynamic torque-vector control 2: V/f control with slip compensation 3: V/f control with speed sensor 4: Dynamic torque-vector control with speed sensor 5: Vector control without speed sensor 6: Vector control with speed sensor 10: Torque control (vector control without speed sensor) 11: Torque control (vector control with speed sensor) Other than the above: Reserved	○	○
Motor selected	Indicates the currently selected motor number. 00_b: Motor 1 01_b: Motor 2 10_b: Motor 3 11_b: Motor 4	×	×
Speed limit ON	"1" is set during speed limit.	×	×
Drive motor type	0 : Induction motor (IM) 1 : Permanent magnet synchronous motor (PMSM)	○	○

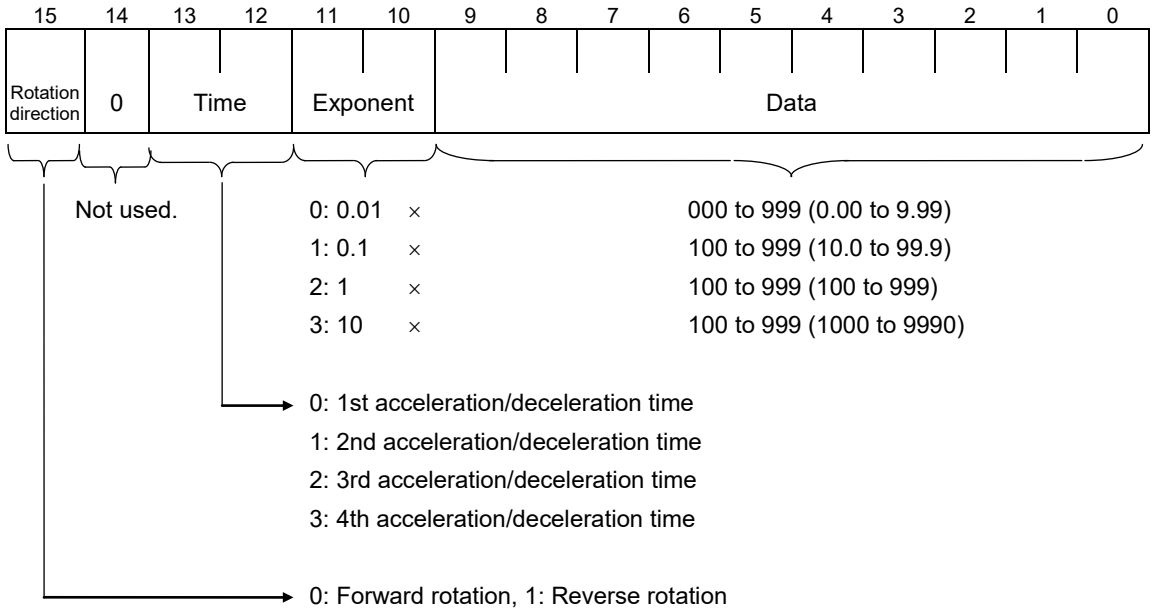
Data format [77] Optional input terminals

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
I16	I15	I14	I13	I12	I11	I10	I9	I8	I7	I6	I5	I4	I3	I2	I1

Data format [78] Optional output terminals

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	08	07	06	05	04	03	02	01

Data format [84] Pattern operation


15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Rotation direction
0
Time
Exponent
Data
Not used.
0: 0.01 ×
1: 0.1 ×
2: 1 ×
3: 10 ×
000 to 999 (0.00 to 9.99)
100 to 999 (10.0 to 99.9)
100 to 999 (100 to 999)
100 to 999 (1000 to 9990)
0: 1st acceleration/deceleration time
1: 2nd acceleration/deceleration time
2: 3rd acceleration/deceleration time
3: 4th acceleration/deceleration time
0: Forward rotation, 1: Reverse rotation

(Example) C22 (Stage 1) = 10.0 s R2 (10.0 seconds, Reverse rotation, Acceleration time 2/Deceleration time 2)

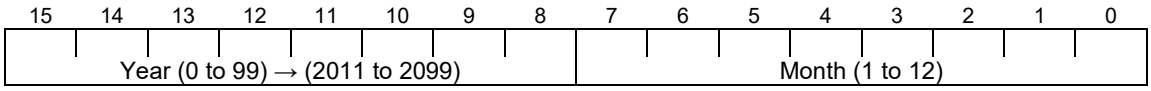
10.0 = 0.1 x 100 ⇒ 9000H + 0400H + 0064H = 9464H ⇒

94_H	64_H

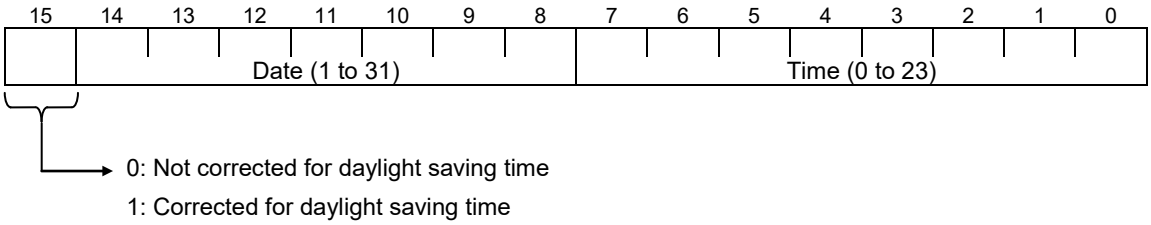
*1 If bit 14 (Not used) ≠ 0, the inverter regards the data as abnormal and responds with NAK.

*2 If Data (bit 9 to bit 0) is out of the range specified above, the inverter regards the data as abnormal and responds with NAK.

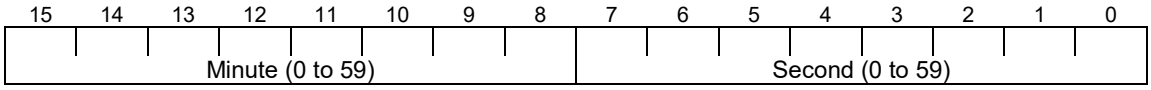
Data format [85] Clock data (Year and month)



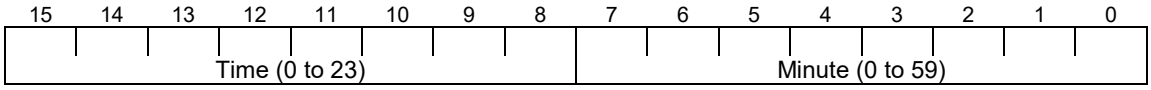
Data format [86] Clock data (Day and time)


15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Date (1 to 31)
Time (0 to 23)
0: Not corrected for daylight saving time
1: Corrected for daylight saving time

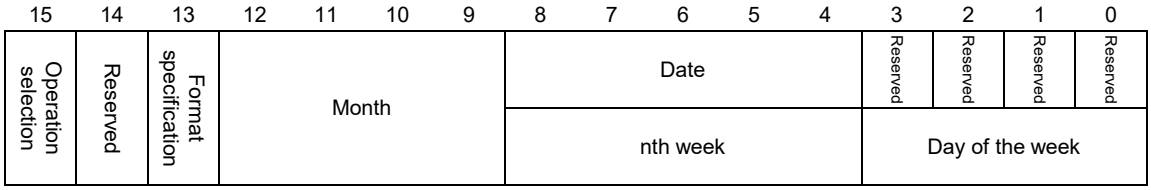
Data format [87] Clock data (Minute and second)



Data format [88] Clock data (Time and minute)



Data format [89] Month and day (for scheduled operation)



(Reserved bits should be always "0.")

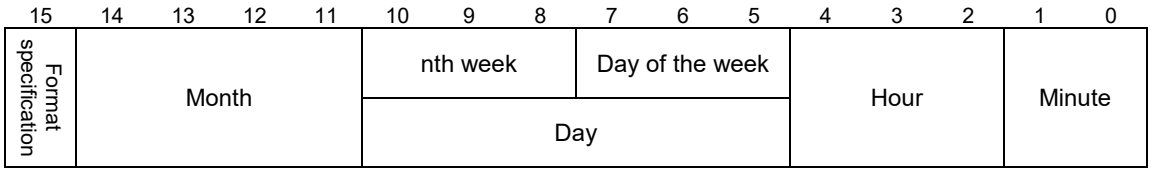
If the format specification = 0 (Month, week, and day of the week):

Item	Contents
Day of the week	0 to 6: Monday to Sunday
nth week	1 to 6: 1st to 6th week 7 to 31: Final week 0: Incorrect. The clock data is treated as invalid.
Month	1 to 12: January to December 0, 13 to 15: Incorrect. The clock data is treated as invalid.
Operation selection	Indicates whether the specified pause date for timer operation is valid or invalid. 0: Invalid (The pause date is invalid. Timer operation is performed on that day.) 1: Valid (The specified day is a timer operation pause date.)

If the format specification = 1 (Month and day):

Item	Contents
Day	1 to 31: 1st to 31st 0: The clock data is treated as invalid.
Month	1 to 12: January to December 0, 13 to 15: The clock data is treated as invalid.
Operation selection	Indicates whether the specified pause date for timer operation is valid or invalid. 0: Invalid (The pause date is invalid. Timer operation is performed on that day.) 1: Valid (The specified day is a timer operation pause date.)

Data format [90] Month, day, time and minute (Correction for daylight saving time)



(Reserved bits should be always "0.")

If the format specification = 0 (Month, week, day of the week):

Item	Contents
Minute	Indicates minutes at 15-minute intervals. 0, 1, 2, 3: 0, 15, 30, 45 minutes
Hour	Indicates hours at one-hour intervals in 24-hour format. 0 to 7: 0 to 7 hours (Any other hours cannot be specified.)
Day of the week	Indicates the day of the week as a number. 0 to 6: Monday to Sunday
nth week	1 to 6: 1st to 6th week 7: Final week 0: Incorrect. The clock data is treated as invalid.
Month	1 to 12: January to December 0, 13 to 15: The clock data is treated as invalid.
Format specification	0: "Month, week and day of the week" format fixed

Data format [91] Relay output terminal

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	Y12A *2	Y11A *2	Y10A *2	Y9A *2	Y8A *2	Y7A *2	Y6A *2	0	Y4A *1	Y3A *1	Y2A *1	Y1A *1

Not used. General-purpose output (Each bit is ON when 1.) Not used. General-purpose output

*1 For option card OPC-RY

*2 For option card OPC-RY2

Data format [93] Floating-point data

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Exponent		Data													

0: 0.1	×	0000 to 9999 (0.0 to 999.9)
1: 1	×	1000 to 9999 (1000 to 9999)
2: 10	×	1000 to 9999 (10000 to 99990)
3: 100	×	1000 to 9999 (100000 to 999900)

*1 If Data (bit 13 to bit 0) is out of the range specified above, the inverter regards the data as abnormal and responds with NAK.

Data format [94] Day of the week data

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Sunday	Saturday	Friday	Thursday	Wednesday	Tuesday	Monday

(Reserved bits should be always "0.")

Data format [95] Customizable logic status data

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Enable/disable steps	Reserved	Reserved	Output type		Reserved	Reserved	Input type 2		Reserved	Reserved	Input type 1		Digital output	Digital input 2	Digital input 1

Item	Contents
Digital input 1 Digital input 2 Digital output	0: OFF, 1: ON
Input type 1 Input type 2 Output type	0: No function assigned, 1: Digital, 2: Analog
Enable/disable steps	0: Disable, 1: Enable

CHAPTER 6

Metasys N2 (N2 PROTOCOL)

Metasys N2 is a serial communications protocol developed by Johnson Controls. It is used in building automation.

Table of Contents

6.1 Messages 6-1
6.1.1 Communications specifications 6-1
6.1.2 Polling/selecting 6-1
6.2 Setting up the FRENIC-HVAC/AQUA 6-2
6.3 Point Mapping Tables 6-3
6.4 Reading and Writing from/to Function Codes 6-5
6.5 Support Command Lists 6-6

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6.1 Messages

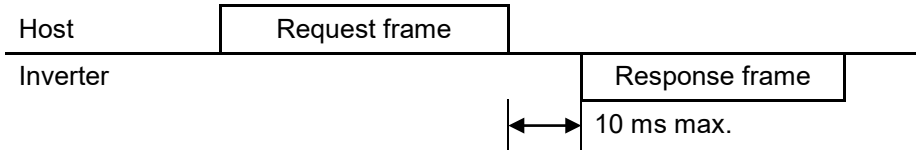
6.1.1 Communications specifications

Item	Specifications
Physical level	EIA RS-485
Wiring distance	1640 ft (500 m) max.
Number of nodes	Total of 255
Transmission speed	9600 bits/s (fixed)
Transmission mode	Half duplex
Bus topology	Master-Slave
Character code	ASCII 7 bits (fixed)
Character length	8 bits (fixed)
Stop bit	1 bit (fixed)
Frame length	Variable length
Parity	None (fixed)
Error checking	Checksum

6.1.2 Polling/selecting

When the FRENIC-HVAC/AQUA receives a request frame from the host, it sends back a response frame.

Polling/ Selecting



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6.2 Setting up the FRENIC-HVAC/AQUA

Run command and reference frequency

To start or stop the inverter or set the reference frequency from Metasys, it is necessary to enable commands given through the appropriate channel using function code H30. For details, refer to Section 2.3.2.

Protocol

Select Metasys N2 (y10 or y20 = 3).

Baud rate

The baud rate on a Metasys N2 network is always 9600 bits/s (y04 or y14 = 2).

Terminating resistors

The end nodes on a Metasys N2 network must be terminated to avoid reflections on the bus line. The FRENIC-HVAC/AQUA is equipped with a termination switch to set a terminating resistor easily. If it serves as a terminating device in a network, the termination switch should be in the ON position. Otherwise the switch should be in the OFF position.

Note: If an external termination connector is used, the switch should be in the OFF position.

Station address

The station address should be set using function code y01 or y11. For details, refer to Chapter 2.

Note: The station address can not be changed when the inverter is in operation.

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6.3 Point Mapping Tables

Accessing the FRENIC-HVAC/AQUA through a Metasys N2 network requires registering point maps to the Metasys.

AI: Analog input
BI: Bit input
AO: Analog output
BO: Bit output

AI and BI point mapping table

NPT	NPA	Units	Description	Range	Notes
AI	1	Hz	Output frequency	0 to 655.35	M09
AI	2	%	Output torque	-327.68 to 327.67	M07
AI	3	%	Output current	0 to 399.99	M11
AI	4	%	Motor output	-327.68 to 327.67	M64
AI	5	Vrms	Output voltage	0.0 to 1000.0	M12
AI	6	-	Alarm history (Latest)	0 to 255	M16
AI	7	-	Alarm history (Last)	0 to 255	M17
AI	8	-	PID output value	-32768 to 32767	M73, 20000 = 100%
AI	9	-	PID feedback value	-32768 to 32767	M72, 20000 = 100%
AI	10	h	Cumulative run time	0 to 65535	M20
AI	11	kWh	Watt-hour	0.001 to 9999	W81
AI	12	-	Control terminal [12] Input voltage	-32768 to 32767	M49, 20000 = 10 V
AI	13	-	Control terminal [C1] Input current	0 to 32767	M50, 20000 = 20 mA
AI	14	-	Control terminal [V2] Input voltage	-32768 to 32767	M54, 20000 = 10 V
AI	15	-	Parameter data read	float	
AI	16	A	Output current	0.00 to 9999	W05
AI	17	kW	Motor output	0.00 to 9999	W22
BI	1	-	FWD	0/1 = Off/On	M14 bit 0
BI	2	-	REV	0/1 = Off/On	M14 bit 1
BI	3	-	Trip	0/1 = Off/On	M14 bit 11
BI	4	-	Frequency arrival signal FAR	0/1 = Off/On	M70 bit 0
BI	5	-	Frequency detection FDT	0/1 = Off/On	M70 bit 1
BI	6	-	Inverter ready to run RDY	0/1 = Off/On	M70 bit 2
BI	7	-	Reserved.	-	
BI	8	-	Reserved.	-	
BI	9	-	Current limiter active	0/1 = Off/On	M14 bit 8
BI	10	-	In acceleration	0/1 = Off/On	M14 bit 9
BI	11	-	In deceleration	0/1 = Off/On	M14 bit 10
BI	12	-	Remote/local	0/1 = Local/remote	
BI	13	-	Y1 terminal	0/1 = Off/On	Defined by E20
BI	14	-	Y2 terminal	0/1 = Off/On	Defined by E21
BI	15	-	Y3 terminal	0/1 = Off/On	Defined by E22
BI	16	-	Y4 terminal	0/1 = Off/On	Defined by E23
BI	17	-	Y5 terminal	0/1 = Off/On	Defined by E24
BI	18	-	30ABC terminal	0/1 = Off/On	Defined by E25

AO point mapping table

NPT	NPA	Units	Description	Range	Notes
AO	1	Hz	Reference frequency	0 to 655.35	S05
AO	2	-	Universal AO	-32768 to 32767	S12, FMA (F31 = 10), 20000 = 100%
AO	3	-	Reserved.	-	
AO	4	-	Reserved.	-	
AO	5	-	Reserved.	-	
AO	6	-	Reserved.	-	
AO	7	s	Acceleration time	0.0 to 3600.0	S08
AO	8	s	Deceleration time	0.0 to 3600.0	S09
AO	9	-	PID command value	-32768 to 32767	S13, 20000 = 100%
AO	10	Hz	Frequency limiter, High	0.0 to 120.0	F15
AO	11	Hz	Frequency limiter, Low	0.0 to 120.0	F16
AO	12		PID mode selection	0 to 2	J01
AO	13	times	PID P-gain	0.000 to 30.000	J03
AO	14	s	PID I-time	0.0 to 3600.0	J04
AO	15		Function code number to read	0 to 65535	See Section 6.4.
AO	16		Function code number to write	0 to 65535	See Section 6.4.
AO	17		Function code data to write	float	

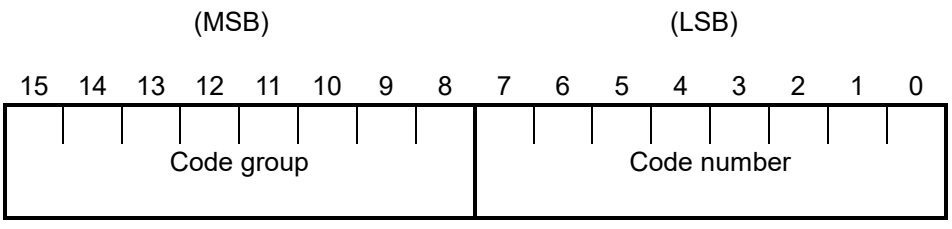
BO point mapping table

NPT	NPA	Units	Description	Range	Notes
BO	1	-	FWD	0/1 = Off/On	S06 bit 0
BO	2	-	REV	0/1 = Off/On	S06 bit 1
BO	3	-	X1	0/1 = Off/On	S06 bit 2
BO	4	-	X2	0/1 = Off/On	S06 bit 3
BO	5	-	X3	0/1 = Off/On	S06 bit 4
BO	6	-	X4	0/1 = Off/On	S06 bit 5
BO	7	-	X5	0/1 = Off/On	S06 bit 6
BO	8	-	X6	0/1 = Off/On	S06 bit 7
BO	9	-	X7	0/1 = Off/On	S06 bit 8
BO	10	-	Reserved.	-	
BO	11	-	Reserved.	-	
BO	12	-	Reserved.	-	
BO	13	-	Reset	0/1 = Off/On	S06 bit 15
BO	14	-	Universal DO Y1	0/1 = Off/On	S07 bit 0, E20 = 27
BO	15	-	Universal DO Y2	0/1 = Off/On	S07 bit 1, E21 = 27
BO	16	-	Universal DO Y3	0/1 = Off/On	S07 bit 2, E22 = 27
BO	17	-	Universal DO Y4	0/1 = Off/On	S07 bit 3, E23 = 27
BO	18	-	Universal DO Y5	0/1 = Off/On	S07 bit 4, E24 = 27
BO	19	-	Universal DO 30ABC	0/1 = Off/On	S07 bit 8, E25 = 27
BO	20		Data protection	0/1 = Off/On	F00

6.4 Reading and Writing from/to Function Codes

Function Code Numbers to Read and Write

Code group			Code name
0	0x00	-	Reserved.
2	0x02	S	Command data
3	0x03	M	Monitor data
4	0x04	F	Fundamental functions
5	0x05	E	Extension terminal functions
6	0x06	C	Control functions
7	0x07	P	Motor 1 parameters
8	0x08	H	High performance functions
9	0x09	-	Reserved.
10	0x0A	o	Option functions
11	0x0B	-	Reserved.
12	0x0C	-	Reserved.
13	0x0D	U	Application functions 3
14	0x0E	J	Application functions 1
15	0x0F	y	Link functions
16	0x10	W	Monitor 2
17	0x11	X	Alarm 1
18	0x12	Z	Alarm 2
19	0x13	-	Reserved.
20	0x14	d	Application functions 2
23	0x17	W1	Monitor 3
24	0x18	W2	Monitor 4
25	0x19	W3	Monitor 5
26	0x1A	X1	Alarm 3
29	0x1D	K	Keypad functions
30	0x1E	T	Clock timer functions
31	0x1F	-	Reserved
32	0x20	H1	High performance 1
33	0x21	-	Reserved.
34	0x22	-	Reserved.
35	0x23	-	Reserved.
36	0x24	J1	Application functions J1
37	0x25	J2	Application functions J2
38	0x26	-	Reserved
39	0x27	J4	Application functions J4
40	0x28	J5	Application functions J5
41	0x29	J6	Application functions J6
42	0x2A	-	Reserved.
247	0xF7	-	Reserved.
248	0xF8	-	Reserved.
252	0xFC	-	Reserved.



6.5 Support Command Lists

Access to a Metasys system uses commands. In the support command lists given below, the FRENIC-HVAC/AQUA supports commands that respond with ACK.

Support Command List 1

Message	Command	Sub command	Region	NPA	Attribute number	Attribute type	Response	Error code	Note
Synch Time	0	0	-	-	-	-	ACK		No action.
Read Memory	0	1	-	-	-	-	NAK	01	
Poll Without ACK	0	4	-	-	-	-	ACK		
Poll With ACK	0	5	-	-	-	-	ACK		
Warm Start	0	8	-	-	-	-	NAK	01	
Status Update Request	0	9	-	-	-	-	ACK		See *1
Read Analog Input (Object Configuration)	1	-	1	0-6	1	Byte	ACK		
Read Analog Input (Object status & Value)	1	-	1	0-6	2	Byte Float	ACK		
Read Analog Input (Value)	1	-	1	0-6	3	Float	ACK		
Read Analog Input	1	-	1	0-6	4-7	-	NAK	11	
Read Analog Input (Low Alarm Limit)	1	-	1	0-6	8	Float	ACK		
Read Analog Input (Low Warning Limit)	1	-	1	0-6	9	Float	ACK		
Read Analog Input (High Warning Limit)	1	-	1	0-6	10	Float	ACK		
Read Analog Input (High Alarm Limit)	1	-	1	0-6	11	Float	ACK		
Read Analog Input (Differential)	1	-	1	0-6	12	Float	ACK		
Read Analog Input	1	-	1	0-6	13-14	Float	NAK	11	
Read Binary Input (Object Configuration)	1	-	2	0-17	1	Byte	ACK		
Read Binary Input (Object status)	1	-	2	0-17	2	Byte	ACK		
Read Binary Input	1	-	2	0-17	3-4	-	NAK	11	

*1 Device manufacturing model number = M23 + M24 + M2 + ”0000”, Days in service = M20, Device status = “0000” .

Support Command List 2

Message	Command	Sub command	Region	NPA	Attribute number	Attribute type	Response	Error code	Note
Read Analog Output (Object Configuration)	1	-	3	0-8	1	Byte	ACK		
Read Analog Output (Object status)	1	-	3	0-8	2	Byte	ACK		
Read Analog Output (Current Value)	1	-	3	0-8	3	Float	ACK		
Read Analog Output	1	-	3	0-8	4-5	Float	NAK	11	
Read Binary Output (Object Configuration)	1	-	4	0-18	1	Byte	ACK		
Read Binary Output (Object status)	1	-	4	0-18	2	Byte	ACK		
Read Binary Output (Minimum On-time)	1	-	4	0-18	3	Integer	ACK		Return attribute value is "00."
Read Binary Output (Minimum Off-time)	1	-	4	0-18	4	Integer	ACK		Return attribute value is "00."
Read Binary Output (Maximum Cycles/Hour)	1	-	4	0-18	5	Integer	ACK		Return attribute value is "00."
Read Binary Output	1	-	4	0-18	6-7	Integer	NAK	11	
Read Internal Parameter	1	-	5-8	-	1-2	-	NAK	01	
Write Analog Input (Object Configuration)	2	-	1	0-6	1	Byte	ACK		
Write Analog Input	2	-	1	0-6	2-7	-	NAK	11	
Write Analog Input (Low Alarm Limit)	2	-	1	0-6	8	Float	ACK		
Write Analog Input (Low Warning Limit)	2	-	1	0-6	9	Float	ACK		
Write Analog Input (High Warning Limit)	2	-	1	0-6	10	Float	ACK		
Write Analog Input (High Alarm Limit)	2	-	1	0-6	11	Float	ACK		
Write Analog Input (Differential)	2	-	1	0-6	12	Float	ACK		
Write Analog Input	2	-	1	0-6	13-14	Float	NAK	11	
Write Binary Input (Object Configuration)	2	-	2	0-17	1	Byte	ACK		
Write Binary Input	2	-	2	0-17	2-4	-	NAK	11	

Support Command List 3

Message	Command	Sub command	Region	NPA	Attribute number	Attribute type	Response	Error code	Note
Write Analog Output (Object Configuration)	2	-	3	0-8	1	Byte	ACK		
Write Analog Output	2	-	3	0-8	2-5	-	NAK	11	
Write Binary Output (Object Configuration)	2	-	4	0-18	1	Byte	ACK		
Write Binary Output (Object status)	2	-	4	0-18	2	Byte	NAK	11	
Write Binary Output (Minimum On-time)	2	-	4	0-18	3	Integer	ACK		No action
Write Binary Output (Minimum Off-time)	2	-	4	0-18	4	Integer	ACK		No action
Write Binary Output (Maximum Cycles/Hour)	2	-	4	0-18	5	Integer	ACK		No action
Write Binary Output	2	-	4	0-18	6-7	Integer	NAK	11	
Write Internal Parameter	2	-	5-8	-	-	-	NAK	11	
Override Analog Input	7	2	1	0-6	-	Float	ACK		No action
Override Binary Input	7	2	2	0-17	-	Byte	ACK		No action
Override Analog Output	7	2	3	0-8	-	Float	ACK		
Override Binary Output	7	2	4	0-18	-	Byte	ACK		
Override Internal Parameter	7	2	5-8	-	-	-	NAK	01	
Override Release Request	7	3	1-8	-	-	-	ACK		
Write Analog Input Attributes Request	7	7	1	0-6	-	-	NAK	01	
Write Binary Input Attributes Request	7	7	2	0-17	-	-	NAK	01	
Write Analog Output Attributes Request	7	7	3	0-8	-	-	NAK	01	
Write Binary Output Attributes Request	7	7	4	0-18	-	-	NAK	01	
Read Analog Input Attributes Request	7	8	1	0-6	-	-	NAK	01	
Read Binary Input Attributes Request	7	8	2	0-17	-	-	NAK	01	
Read Analog Output Attributes Request	7	8	3	0-8	-	-	NAK	01	
Read Binary Output Attributes Request	7	8	4	0-18	-	-	NAK	01	

Support Command List 4

Message	Command	Sub command	Region	NPA	Attribute number	Attribute type	Response	Error code	Note
Identify Device Type	F	-	-	-	-	-	ACK		Device code = "10"
Upload Request	8	0-1	-	-	-	-	NAK	01	
Upload Record	8	3	-	-	-	-	NAK	01	
Upload Complete	8	4	-	-	-	-	NAK	01	
Download Request	9	0-1	-	-	-	-	NAK	01	
Download Record	9	3	-	-	-	-	NAK	01	
Download Complete	9	4	-	-	-	-	NAK	01	

CHAPTER 7

BACnet MS/TP

BACnet MS/TP is a serial communications protocol defined by ANSI/ASHRAE Standard 135-1995. It is used in building automation.

Table of Contents

7.1 Messages 7-1
7.1.1 Communications specifications 7-1
7.2 Setting up the FRENIC-HVAC/AQUA 7-2
7.3 Property Identifiers 7-3
7.4 Binary Point Table 7-4
7.5 Analog Point Table 7-6
7.6 Reading and Writing from/to Function Codes 7-7

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7.1 Messages

7.1.1 Communications specifications

Item	Specifications
Physical level	EIA RS-485
Wiring distance	500 m (1640 ft) max.
Number of nodes	Total of 128
Transmission speed	9600, 19200, 38400 bits/s
Transmission mode	Half duplex
Bus topology	Master-Slave/Token Passing (MS/TP)
Character code	ASCII 7 bits (fixed)
Character length	8 bits (fixed)
Stop bit	1 bit (fixed)
Frame length	Variable length
Parity	None (fixed)
Error checking	CRC

7.2 Setting up the FRENIC-HVAC/AQUA

Node address

Set the node address within the range of 0 to 127 using function code y01 or y11. Setting 128 or more is treated as 127.

Baud rate

Select the baud rate using function code y04 or y14. The typical baud rate of BACnet is 9600 bits/s. In addition to 9600 bits/s, the FRENIC-HVAC/AQUA can select 19200 and 38400 bits/s.

Selecting 2400 or 4800 bits/s is treated as 9600 bits/s.

Protocol

Select BACnet (y10 or y20 = 5).

Character length, parity, and stop bit

These are fixed in BACnet. No setting is required.

Terminating resistors

The end nodes on a BACnet network must be terminated to avoid reflections on the bus line. The FRENIC-HVAC/AQUA is equipped with a termination switch to set a terminating resistor easily. If it serves as a terminating device in a network, the termination switch should be in the ON position. Otherwise the switch should be in the OFF position.

Note: If an external termination connector is used, the switch should be in the OFF position.

7.3 Property Identifiers

The FRENIC-HVAC/AQUA supports the following property identifiers.

Property Identifier	Enum Value	Device	Analog Input	Analog Output	Analog Value	Binary Input	Binary Output	Binary Value	Remarks
Object Identifier	75	Y	Y	Y	Y	Y	Y	Y	
Object Name	77	Y	Y	Y	Y	Y	Y	Y	
Object Type	79	Y	Y	Y	Y	Y	Y	Y	
System Status	112	Y	N	N	N	N	N	N	OPERATIONAL (fixed)
Vendor Name	121	Y	N	N	N	N	N	N	FUJI
Vendor Identifier	120	Y	N	N	N	N	N	N	See Appendix table.
Model Name	70	Y	N	N	N	N	N	N	FUJI-FRENIC-HVAC FUJI-FRENIC-AQUA
Firmware Revision	44	Y	N	N	N	N	N	N	See Appendix table.
Application Software Version	12	Y	N	N	N	N	N	N	ex) 1900
Protocol Version	98	Y	N	N	N	N	N	N	1
Protocol Revision	139	Y	N	N	N	N	N	N	See Appendix table.
Protocol Services Supported	97	Y	N	N	N	N	N	N	
Object List	76	Y	N	N	N	N	N	N	
Max APDU Length Accepted	62	Y	N	N	N	N	N	N	
Segmentation Supported	107	Y	N	N	N	N	N	N	NO_SEGMENTATION (3)
APDU Timeout	11	Y	N	N	N	N	N	N	See Appendix table.
Number of APDU Retries	73	Y	N	N	N	N	N	N	See Appendix table.
Device Address Binding	30	Y	N	N	N	N	N	N	NULL
Database Revision	155	Y	N	N	N	N	N	N	1
Present Value	85	N	Y	Y	Y	Y	Y	Y	
Status Flags	111	N	Y	Y	Y	Y	Y	Y	
Event State	36	N	Y	Y	Y	Y	Y	Y	
Out of Service	81	N	Y	Y	Y	Y	Y	Y	
Units	117	N	Y	Y	Y	N	N	N	
Polarity	84	N	N	N	N	Y	Y	N	
Priority Array	87	N	N	Y	Y *1	N	Y	Y *1	
Relinquish Default	104	N	N	Y	Y *1	N	Y	Y *1	
Max Master	64	Y	N	N	N	N	N	N	See Appendix table.
Max Info Frame	63	Y	N	N	N	N	N	N	See Appendix table.

*1 Not supported in Object of Read only type.

Appendix table

Property Identifier	HVAC/AQUA Inverter ROM version	
	1850 or earlier	1900 or later (Listed by BTL)
Vendor Identifier	163	700
Firmware Revision	1.00	2.00
Protocol Revision	4	12
APDU Timeout	3000 ms	0
Number of APDU Retries	3	0
Priority Array	NULL	Supported
Max Master	Not supported	127
Max Info Frames	Not supported	1

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7.4 Binary Point Table

The binary point table contains bitwise signals that command the inverter and indicate the inverter status. The FRENIC-HVAC/AQUA supports the following.

Object Name	Object Type	Object Instance	Active Text	Inactive Text	Function code	R/W
Forward_Command	BV	0	Forward	Inactive	S06: bit 00	R/W
Reverse_Command	BV	1	Reverse	Inactive	S06: bit 01	R/W
Alarm_Reset	BV	2	Reset	Inactive	S06: bit 15	R/W
Forward_Rotation	BV	3	Forward	Inactive	M14: bit 00	R
Reverse_Rotation	BV	4	Reverse	Inactive	M14: bit 01	R
DC_Braking/Pre_exicing	BV	5	Braking	Inactive	M14: bit 02	R
Inverter_Shut_Down	BV	6	Shutdown	Inactive	M14: bit 03	R
Braking	BV	7	Braking	Inactive	M14: bit 04	R
DC_Voltage_Est	BV	8	Established	Inactive	M14: bit 05	R
Torque_Limiting	BV	9	Limiting	Inactive	M14: bit 06	R
Voltage_Limiting	BV	10	Limiting	Inactive	M14: bit 07	R
Current_Limiting	BV	11	Limiting	Inactive	M14: bit 08	R
Acceleration	BV	12	Accelerating	Inactive	M14: bit 09	R
Deceleration	BV	13	Decelerating	Inactive	M14: bit 10	R
Alarm_Relay	BV	14	Alarm	Inactive	M14: bit 11	R
Communications_Act	BV	15	Effective	Inactive	M14: bit 12	R
Busy	BV	16	Busy	Inactive	M14: bit 15	R
X1_Communications	BV	17	Active	Inactive	S06: bit 02	R/W
X2_Communications	BV	18	Active	Inactive	S06: bit 03	R/W
X3_Communications	BV	19	Active	Inactive	S06: bit 04	R/W
X4_Communications	BV	20	Active	Inactive	S06: bit 05	R/W
X5_Communications	BV	21	Active	Inactive	S06: bit 06	R/W
X6_Communications	BV	22	Active	Inactive	S06: bit 07	R/W
X7_Communications	BV	23	Active	Inactive	S06: bit 08	R/W
XF_Communications	BV	24	Active	Inactive	S06: bit 13	R/W
XR_Communications	BV	25	Active	Inactive	S06: bit 14	R/W
X1_Final	BI	1	Active	Inactive	M13: bit 02	R
X2_Final	BI	2	Active	Inactive	M13: bit 03	R
X3_Final	BI	3	Active	Inactive	M13: bit 04	R
X4_Final	BI	4	Active	Inactive	M13: bit 05	R
X5_Final	BI	5	Active	Inactive	M13: bit 06	R
X6_Final	BI	6	Active	Inactive	M13: bit 07	R
X7_Final	BI	7	Active	Inactive	M13: bit 08	R
EN_Final	BI	8	Active	Inactive	M13: bit 11	R
XF_Final	BI	9	Active	Inactive	M13: bit 13	R
XR_Final	BI	10	Active	Inactive	M13: bit 14	R
Y1_Communications	BO	1	Active	Inactive	S07: bit 00	R/W
Y2_Communications	BO	2	Active	Inactive	S07: bit 01	R/W
Y3_Communications	BO	3	Active	Inactive	S07: bit 02	R/W
Y4_Communications	BO	4	Active	Inactive	S07: bit 03	R/W
Y5_Communications	BO	5	Active	Inactive	S07: bit 04	R/W
30_Communications	BO	6	Active	Inactive	S07: bit 08	R/W

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About binary points

BV0 to BV2 and BV17 to BV25 enable access to each bit of communications command S06.

BI1 to BI10 indicate the final values of run commands being recognized by the inverter, including S06.

To change communications commands from the host, use BV0 to BV2 and BV17 to BV25.

7.5 Analog Point Table

The analog point table contains analog data that commands the inverter and indicates the inverter internal data. The FRENIC-HVAC/AQUA supports the following data.

For details about the unit and setting range of each data, refer to each function code of data formats in Chapter 5.

Object instance	Object type	Units	Object name	Function code	R/W
0	AV	Hz	Frequency_Command_Setpt	S05	R/W
1	AV	%	PID_cmd	S13	R/W
2	AV	Hz	Frequency_Command	M05	R
3	AV	%	Output_Torque	M07	R
4	AV	%	Input_Power	M10	R
5	AV	%	Output_Current	M11	R
6	AV	V	Output_Voltage	M12	R
7	AV	-	Latest_Alarm	M16	R
8	AV	h	Operation_Time	M20	R
9	AV	V	DC_Link_Voltage	M21	R
10	AV	°C	Inverter_Air_Temp	M61	R
11	AV	°C	Inverter_Heat_Sink_Temp	M62	R
12	AV	-	PID_Feedback	M72	R
13	AV	-	PID_Output	M73	R
14	AV	-	Parameter_Select *1	-	R/W
15	AV	-	Parameter_Value *2	-	R/W
0	AO		Universal_AO	S12	R/W

*1 Enter a function code address to Parameter_Select (AV14). For function code addresses, refer to Section 7.6.
For the firmware revision 1.0, set HEX-code to AV14. If the function code is S05, for example, set "0x705" to AV14.
For the firmware revision 2.0, set Real number to AV14. If the function code is S05, for example, set "1797.000" to AV14.

*2 If a requested parameter value is not supported, the FRENIC-HVAC/AQUA returns a value of zero.
For the firmware revision 1.0, set HEX-code to AV15. If data is "58.23" (Hz), for example, set "0x16bf" to AV15.
For the firmware revision 2.0, set Real number to AV15. If data is "58.23" (Hz), for example, set "58.230" to AV15.

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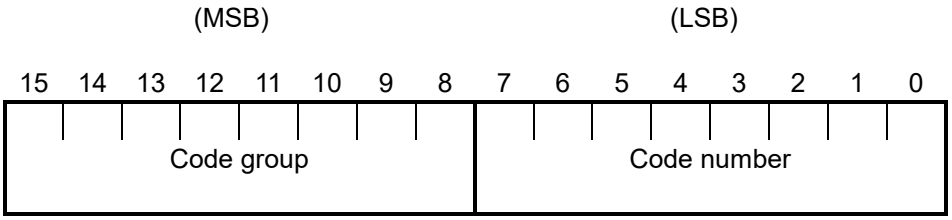
7.6 Reading and Writing from/to Function Codes

Function Code Numbers to Read and Write

Code group			Name	Code group			Name
F	0	00_H	Fundamental functions	M	8	08_H	Monitor data
E	1	01_H	Extension terminal functions	J	13	$0D_H$	Application functions 1
C	2	02_H	Control functions	d	19	13_H	Application functions 2
P	3	03_H	Motor 1 parameters	U	11	$0B_H$	Application functions 3
H	4	04_H	High performance functions	L	9	09_H	Reserved.
A	5	05_H	Reserved.	y	14	$0E_H$	Link functions
b	18	12_H	Reserved.	W	15	$0F_H$	Monitor 2
r	10	$0A_H$	Reserved.	X	16	10_H	Alarm 1
S	7	07_H	Command/Function data	Z	17	11_H	Alarm 2
o	6	06_H	Operational functions	J1	48	30_H	Application functions
W1	22	16_H	Monitor 3	J2	49	31_H	Application functions
W2	23	17_H	Monitor 4	J3	50	32_H	Reserved.
W3	24	18_H	Monitor 5	J4	51	33_H	Application functions
X1	25	19_H	Alarm 3	J5	52	34_H	Application functions
K	28	$1A_H$	Keypad functions	J6	53	35_H	Application functions
T	29	$1B_H$	Timer functions	K1	206	CE_H	Reserved.
H1	31	$1F_H$	High performance functions 1	K2	207	CF_H	Reserved.
U1	39	27_H	Customizable logic functions				



FRENIC-HVAC
FRENIC-AQUA

RS-485 Communication User's Manual

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Fuji Electric Co., Ltd.

The purpose of this manual is to provide accurate information in the handling, setting up and operating of the FRENIC-HVAC/AQUA series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will Fuji Electric Co., Ltd. be liable for any direct or indirect damages resulting from the application of the information in this manual.

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